SCIENCE

VOL. 92 FRIDAY, NOVEMBER 8, 1940 No. 2393

The National Academy of Sciences:
Address of Welcome by the President of the University of Pennsylvania: DR. THOMAS S. GATES 411
Remarks at the Dinner by the President of the Academy: DR. FRANK B. JEWETT 412
Abstracts of Papers 415
Obituary:
Henry McElderry Knower: PROFESSOR ROSS G. HARRISON. *Recent Deaths and Memorials* 419
Scientific Events:
The U. S. Weather Unit at Harvard University; The Canal Zone Biological Area; The Lalor Foundation; The Administration of the E. R. Squibb and Sons Award; The Permanent Science Fund of the American Academy of Arts and Sciences; The Chemical Exposition 422
Scientific Notes and News 424
Discussion:
On the Theory of the Separation of Isotopes by Thermal or Centrifugal Methods: DR. ARTHUR BRAMLEY. *The Standardization of Osmotic Pressure as a Term:* PROFESSOR S. C. BROOKS. *Equinoxes and Solstices:* DR. W. J. HUMPHREYS. *Reference Citations and Microfilm:* MARTIN D. YOUNG and DR. G. ROBERT COATNEY 427
Scientific Books:
Progress by Cooperation: DR. FRANS VERDOORN 430
Special Articles:
A Cancerogenic Tissue Extract from Human Sources: DR. PAUL E. STEINER. *Radioactive Carbon as a Tracer in the Synthesis of Propionic Acid from CO_2 by the Propionic Acid Bacteria:* DR. S. RUBEN and OTHERS. *Massive "Acute" Precipitation of Free Sulfathiazole in the Urinary Tract:* DR. WILLIAM ANTOPOL, DR. DAVID LEHR and DR. JACOB CHURG 431
Scientific Apparatus and Laboratory Methods:
A Modification of Riddle's Method of Prolactin Assay: NAO UYEI and OTHERS. *Cellophane Cover Slips and a Method for Mounting:* IRENE BUCHOLTZ 435
Science News 8

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

THE NATIONAL ACADEMY OF SCIENCES[1]

ADDRESS OF WELCOME BY THE PRESIDENT OF THE UNIVERSITY OF PENNSYLVANIA

THE University of Pennsylvania has special gratification in extending a hearty welcome to the members of your distinguished body in the annual meeting which you are holding this week within our halls. You bring to our campus a group of scientists and educators who feel a certain definite obligation to the state in the several fields in which they are involved. Your association is one of creative possibilities. As your president pointed out in his remarks at the dinner of the academy a year ago your organization traces its origin into Colonial times, but there is a certain significance to the impetus which the movement gained through its incorporation under the approval of Abraham Lincoln at the time of our Civil War. And one reads with new inspiration these words from the first annual report of the academy submitted to Congress a year later:

> It is a remarkable fact in our annals that, just in the midst of difficulties which would have overwhelmed less resolute men, the 37th Congress of the United States, with an elevated policy worthy of the great nation which they represented, took occasion to bring the scientific men around them in council on scientific matters, by creating the National Academy of Sciences. Such has been the way in which the public mind has been stirred before in the annals of other countries, leading to the organization of great systems of education, science, art and literature, to be encouraged and perfected when more peaceful and prosperous times recurred.

This historic association augments the significance of the academy by the tradition of a great man, the mere mention of whose name makes us search our hearts with a view of doubling the earnestness of our efforts.

Now that the progress of civilization is imperiled by the unbridled and destructive forces of evil which

[1] Autumn meeting held at the University of Pennsylvania, Philadelphia, October 28, 29 and 30, 1940.

have been unleashed abroad, you on your part stand prepared to furnish to your government all the resources which can be brought to bear through the academy, and through its instrumentality, the National Research Council, organized for the purpose among other things of strengthening the national defense and cooperating in the interest of the public welfare. And we on our part have offered to our government every man and every facility at our command for such purpose in the national emergency as our government may think helpful in the grave problems it has in hand. Our preparation involves also the organization of base hospitals, the setting up of Army, Navy and Pilot training corps, and our cooperation with plans having to do with registration and special researches and services bearing upon national defense. As before in our history when our services were useful or needed, we stand ready to make available to all departments of the Federal Government the special abilities, experiences and the capacities of each and every activity we possess.

You come to the university in a year of great meaning to us. Founded by the many-sided Franklin two hundred years ago we find ourselves interwoven with the academy through a distinguished group of scholars deeply grounded in the objectives of each institution. Beginning with Bache, and coming through Frazier, Leidy, Lesley and two Rogers, Longstreth, Cope, Donaldson, Mitchell and Wood, we can trace adventures into the unknown through the dramatic lives of those who between us had common interests. By coming here in this special year you demonstrate again the vitality of democracy, the unity of purpose of intelligent men and the power of education, which in these times gives renewed faith and encouragement to us all. It is well that in some place there should be provided at just this time in the history of the world a platform from which the best minds in all fields of useful knowledge could give encouragement to a weary world. And while the location of such an event is not nearly so important as the circumstance it seems appropriate that the scene should be here in Philadelphia which saw the birth of American liberty, and is to-day more than ever a shrine from which free men may renew their inspiration. The bicentennial celebration of this university, which is being observed throughout the year, reached in a sense its high point during the present fall and the observances which have occurred emphasize again the fact that knowledge and learning know no boundaries of nationality, of creed, of race or social preference. We have all been inspired by the fact that great scientists and humanists invited to our commemoration came with enthusiasm and with generosity, and that those who could not come from overseas because of the war heroically stayed at home but sent to us for the benefit of learning and welfare their papers to be read by other colleagues in the free realm of scholarship.

From countries on both sides of the European and the Asiatic wars came messages of hope of a new tomorrow. From men of universities no longer in existence came letters and cablegrams pleading that the fires of freedom be kept burning as the hope of civilization. "Free science in America means free science for all the world," wrote the delegate from the University of Latvia, whose faculties have been banished.

Institutions such as those with which you and we are associated and the forces which lie back of them are older than any government in the world. Around them liberty and independence have grown. Education that is free and virile can exist only in a democracy. And democracy can exist only where education and intelligence grow guided by such institutions as yours and ours leading the people along pathways that are free and upward. Therein rests the hope of civilization for the kind of a future for which intelligent men and women are even now giving their genius, their energies and their lives.

One can not overstate the significance of a meeting such as this at the present time. Nor can one overestimate the lasting values which may result from our association together. There is inherent in the event the acceptance of the challenge to our collective abilities to meet and overcome the onslaught of a world ridden by fear.

THOMAS S. GATES

REMARKS AT THE DINNER BY THE PRESIDENT OF THE ACADEMY

THIS is neither the time nor occasion for any extended remarks on my part. Nevertheless I do wish to trespass on your good nature for a few minutes. I have learned something out of my experience these past eighteen months as President of the National Academy of Sciences which I would like to convey to you—members and guests alike.

To the members, particularly to those who have been members long, it is not particularly new, nor, as they may remember, is this my first reference to it. My justification for reverting to it now is that it is at present an important matter in connection with the functioning of the academy. To these older members I crave pardon in advance.

To you who are our guests, what I have to say is probably new. To all of you, members and guests alike, who are interested in or concerned with the *raison d'être* of the academy it is, I think, something you should understand clearly.

I suspect that most people outside its membership think of the National Academy of Sciences as some sort of a voluntarily created scientific society of limited membership, which differs from numerous other

scientific and technical societies only in that its membership covers a wide range of scientific fields. They may or may not know that membership is attained not by application but by a rigorous and somewhat laborious process of election which involves judgment of a candidate's scholarly fitness. This judgment is not merely that of men in the candidate's own particular field but is equally the judgment of those in all the other fields comprised within the academy structure. Further, they may or may not know that final election is not by ballot of all the members of the academy but is by secret ballot of those members present at the annual meeting, taken after full discussion of the candidate's scientific achievements. So far as men are capable of doing it, this process seeks to select men judged to be eminent in some field of fundamental or applied science. Finally, the outsider may or may not know that the members of the academy gather together occasionally to present and discuss noteworthy new discoveries in science in a wide variety of fields, and once a year to replenish their limited membership.

In normal peaceful times, this is about all there is to the academy, so far as most of its members, as well as those outside its ranks, are concerned. Only the officers and the few members of standing committees or those concerned with the active work of its great agent, the National Research Council, are in such times kept continually alive as to what the academy really is. During these quiescent periods some, even of the members, tend quite naturally to consider the academy merely as something pleasant to belong to—a sort of exclusive scientific club, as it were, made up of men and women of distinction in science with a magnificent marble home in Washington.

Actually the academy is something quite different from this. It is *not* a self-perpetuating voluntary association but a self-perpetuating corporation chartered by Congress for a very definite and specific purpose. It is in fact a permanent quasi instrument of the Federal Government. By accepting election to membership in it men and women accept responsibility to serve the nation without remuneration whenever requested to do so by the government.

The Congressional Charter approved by President Lincoln, March 3, 1863, is an astounding state paper which pays tribute to the statesmanship not only of Mr. Lincoln but of A. D. Bache, the academy's first president, Louis Agassiz, Asa Gray, Joseph Henry, Benjamin Silliman and the numerous other distinguished scientists of the time. These men, who were the original members of the academy, were not a voluntary association of men having a common interest in science. They were designated by Congress as the original members of a permanent corporation created by the supreme authority of the nation. The fact that among these original designated members were a considerable number of distinguished Army and Navy officers is evidence of a primary purpose which Congress and the President had in mind.

The entire Act of Incorporation consists of but three sections and covers less than a single small printed page. The first section, which comprises nearly two thirds of the document, is a mere recital of the names and states of residence of the incorporating members—ten of whom were from Pennsylvania. The second section, of seven lines, gives the corporation what is essentially a white card as to all things pertaining to its operation, including its rules and the election of members. It also provides for reports to Congress.

In the original charter Section 2 also limited the number of members to 50. By further Act of Congress in 1870, all limitation of numbers was removed and membership was left to the sole discretion of the corporation.

The last section, of less than a hundred words, provides that the academy shall hold an annual meeting at some place of its own choosing within the United States. It also imposes the obligation that ". . . the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art . . ." the actual expenses to be paid by government but the academy to receive ". . . no compensation whatever for any services to the Government of the United States."

This Section 3, which is always incorporated in any contracts or formal understandings of the academy with government departments, is the price exacted of the academy for the complete freedom accorded it in Section 2. It is also the proviso which indirectly over the past seventy-five years has determined the qualification of men for membership and the whole machinery of nomination and election.

By this simple expedient of giving the academy essentially unlimited freedom to administer its own affairs and in return exacting merely an obligation to serve the nation when requested, the charter in effect ordained that the membership should always consist of men and women of established scientific competence, since otherwise the academy could not carry out its charter obligation.

In normal times the requests of government on the academy are not numerous and usually not of an urgent character. They never deal with unimportant matters, however.

In times of stress, like the present, things are quite the reverse. Requests for advice then become numerous and more frequently than not, urgent.

Beginning about two years ago, requests began to peak up in accelerated fashion and during the past

eighteen months the academy, either directly or through its agent, the National Research Council, has been called upon to advise, study and report on a wide variety of matters, in which the actual costs paid by government under the charter are running at the rate of a number of hundred thousand dollars a year. When it is remembered that the services of the academy and its members, and the services of all those it appoints on its committees, are furnished without remuneration, the full scope of the aid rendered by the academy under its charter obligations can be appreciated.

These requests for study and advice have come from the President, from numerous branches of the Army and Navy, and from many of the civil departments, boards and commissions, both permanent and temporary. The problems these requests present are vastly more varied than are their origins. Recently numerous requests for assistance involving much work have come from temporary defense organizations, and more are in prospect. Many of them are matters of great urgency involved in decisions of public policy and the expenditure of large sums of public money.

The permanent organization of the academy and council, built up over the years, is of inestimable value in selecting quickly the most qualified men in any field of science for the particular study required.

While the load of work imposed on the officers of the academy and council and on many of the members in handling these requests has disabused our minds of any lurking thought we may have harbored that membership was an ornamental sinecure, it has been an interesting experience. So far as I personally am concerned, it has given me added respect for those men who, in the midst of a devastating civil war, could create in such a simple structure an organization so lasting, so powerful and so flexible to changing conditions as the one they adopted. It is difficult for me to conceive of a more effective structure for insuring that at all times government be in position to avail itself of the most competent unbiased assistance science can provide. Temporary organizations have been in the past, are now and will continue to be created in times of emergency to supplement the work of the academy and council. They are, however, more likely than not to pass off the stage with the passage of the emergency which brought about their creation.

As indicated above, the simple expedient adopted by Congress in the academy's charter forged the strongest possible chains of service. Because it appeals merely to the honor of men, nothing can be more compelling than an obligation to serve, coupled with a guarantee of complete freedom to render that service in the best way they can themselves devise. The strength of the academy and its ability to discharge its obligations lies solely in the character and eminence of its members and of those it selects to aid it. It does not reside in numbers, since there is no limitation to those it may ask to aid on occasion, nor does it reside in any statutory authority to enforce its findings or opinions. Fortunately, the academy has no such power and so no temptation to become dictatorial.

The most powerful force within the academy and about the only one which acts on all of the members is therefore the one concerned with the quality of men. The fact that the load of work is unequally distributed among the membership, and that many of the members may never be called upon to render personal service, matters little. The character of the problems presented determines where the burden will fall. What is important, and what makes it possible for the academy directly and indirectly to render service, is that it should be composed of men and women who have established their competence as real contributors to an enlarging science.

If further proof be needed of the power of the simple setup of seventy-seven years ago, it is to be found in the fact that not once in the many scores of calls for personal time-consuming unremunerated assistance that the academy has made on men during the past year has there been a single declination. While many of the calls have been to members of the academy or National Research Council, the great majority have been to men outside either. Nor has there been, so far as I am aware, a single instance in which the advice given government has not been followed or has been questioned.

So long as the eminence of its membership is maintained, the Congressional Charter provides an almost impregnable citadel for disinterested service to the nation. It is a shield against the pressures of expediency, influence and the thousand and one things which so frequently bedevil and thwart our group undertakings.

I have a feeling that the pattern of permanent formal relationship between government and self-operating groups of its citizens, exemplified by the academy charter, could be copied to great advantage in numerous other fields.

To give you some idea of the scope and variety of the problems which have been submitted to the academy during the past year, the following partial list may be of interest. Some of them have been handled by committees of the academy alone and more by committees jointly appointed by the academy and council. Due to the magnitude and increasing complexity of the problems we are more and more employing the joint committee scheme.

1. From the President of the United States—Study and report on a method of instrument (blind) landing for aeroplanes to be standardized and employed at major flying fields.

2. From the Civil Aeronautics Authority—Comprehensive study of the whole method of selection and training of pilots. This is a very considerable task which is extending over two years, and which involves work at many institutions of learning.

3. From the National Resources Planning Board—Study and report on industrial research in the United States.

4. From the Advisory Commission to the Council of National Defense—(a) Study and report on the whole problem of utilizing domestic low-grade manganese ores; and (b) Study and report on the erection of a tin smelter to refine low-grade tin ores from Bolivia.

5. From the Army and Navy—Numerous problems concerned with National Defense. Some of these are handled by permanent committees of the academy and some by special joint committees. Many of them involve much and long-continued work and the expenditure of large sums of money.

These are but samples picked at random from a long list.

FRANK B. JEWETT

ABSTRACTS OF PAPERS

A white-flowered race of Datura from aged seed which is genetically distinct from similar white races in nature: ALBERT F. BLAKESLEE and A. G. AVERY. In *Datura stramonium* there are two color forms, one with white flowers and green stems, the other with purple flowers and stems. In the current manuals they are recognized as distinct species, *D. stramonium* and *D. tatula,* but differ only in a single pair of genes located in the ·18 half of the 17·18 chromosome. From seeds aged 7½ years, a recessive white-flowered type segregated out in the F_2 generation which was indistinguishable in appearance from the wild whites. When crossed with a standard white from nature, the F_1 plants were purple, a fact which showed we were dealing with a new gene for white. By appropriate tests this new gene has been located in the ·16 half of the 15·16 chromosome. The possibility that more than one recessive gene might be responsible for the different wild whites was tested by crossing standard white testers with over 400 white races from nature. If any of these whites had been determined by a different gene from that responsible for the white flowers of the tester, their F_1's would have been purple. The F_1's, however, were all white, a fact which proves that there was only one gene for white flowers in the 400 races. Since these races were secured from widely separate parts of the world, including all the continents, and represented all the recurrent chromosomal types found in nature, it is probable that no new gene for white flowers in this species has become established in the wild. In *D. ferox,* a gene for white flowers which is located in the ·4 half of the 3·4 chromosome causes the corolla and stamens to be white and the stem and leaves above the cotyledons to be green. In flower color the herbaceous Daturas are limited to two types—purple and white.

Physiological differentiation of Astragalus in response to selenium: SAM F. TRELEASE (introduced by W. J. Robbins). The growth of *Astragalus racemosus* and *A. pattersonii* in solution and sand cultures was greatly increased by the element selenium (as selenite or selenate) in concentrations up to 27 ppm., and the plants accumulated large quantities of selenium. Selenium seems to be an essential mineral element for these species of *Astragalus.* In marked contrast, *A. crassicarpus* was not stimulated by selenium in the culture solution but was instead poisoned, being severely injured by 0.33 ppm. and killed by 9 ppm. This species is able to absorb only small quantities of selenium, and its physiological response is like that of wheat, buckwheat, soy beans or tobacco. *A. racemosus* and *A. pattersonii* are indicators of seleniferous areas. But *A. crassicarpus,* since it is neither benefited by selenium nor poisoned by the very low concentrations existing in natural soils, does not serve as an indicator. Field studies in collaboration with Professor O. A. Beath have shown thus far that twenty-three other species are like *A. racemosus* and *A. pattersonii* in being selenium indicators, whereas many other species of *Astragalus* resemble *A. crassicarpus* in being indifferent to selenium in natural soils. The indicator species fall into six of the twenty-nine groups into which M. E. Jones divided the genus *Astragalus* on the basis of morphological characters. All members so far examined in the groups Bisulcati, Ocreati, Podo-sclerocarpi and Preussii are selenium indicators; and no member studied in the groups Uliginosi, Flexuosi, Inflati, Homalobi, Angophylli and Hypoglottides is a selenium indicator. The groups Galegiformes and Lonchocarpi seem to require revision, since each includes both indicator and non-indicator species. Physiological differentiation of *Astragalus* with reference to selenium provides a new approach to the division of this difficult genus into groups representing relationships and evolutionary development.

Sensitivity of gladiolus corms during an artificially prolonged rest period: FRANK E. DENNY (introduced by B. O. Dodge). Although gladiolus corms when freshly harvested are dormant, they pass through this rest period, usually in one to three months, and then will germinate promptly when planted. This rest period may be prolonged for many months or for two years or more with certain varieties by the simple expedient of replanting the *freshly harvested* corms in *moist soil* and *storing at room temperature* or preferably at about 27° C. With the passage of time, corms with a rest period artificially prolonged in this way become sensitive to low temperatures, such as 0° and 5° C. Germination can then be induced by short periods of chilling such as 48, 24, 12 or even 6 hours, depending on the variety and the duration of the period of enforced rest at the time of the exposure to cold. During this long rest period the corms show an exceptional type of respiration. When first removed from the soil after a sojourn in it of several or even a few months, the carbon dioxide production at the temperature which prevailed during the storage in soil is very low, approximately 2 to 10 mg CO_2 per kg per hour. This low rate is maintained, however, for only 4 to 8 hours,

when the rate rises rapidly until within 24 to 48 hours it reaches 20, 40, 80 or even more than 100 mg. From this maximum the respiration curve falls gradually until after 5 to 7 days the original low rate is reached, this being maintained indefinitely. In spite of this great change in respiratory activity the rest period is not broken, but these corms retain their dormancy, may be again planted in soil and become available for another respiration test. The curve is again given by a subsequent test, provided the period in the soil following the first removal is approximately three months. During the first few hours after removal from the soil (when the rate is low and rising) the volume of oxygen taken in is much larger than the volume of carbon dioxide given off, approximately two to three times as large; but at the time of the maximum rate, and in the entire period during the falling rate, even to the time of the secondary minimum, the volumes of O_2 and CO_2 are equal.

Growth of excised roots and heterosis in tomato: WILLIAM J. ROBBINS. Excised roots of two inbred lines of tomato and the heterotic F_1 were grown under sterile conditions in liquid media. The seeds from which the excised roots came were furnished through the courtesy of C. B. Lyon. The roots were grown in a mineral salt-sugar solution supplemented with thiamin, with thiamin and vitamin B_6 or with thiamin, vitamin B_6 and nicotinic amide. Under the experimental conditions used the roots of the hybrid grew more in all three types of solutions than those of either parent. The roots of one parent showed a greater response to vitamin B_6 than to nicotinic amide, the roots of the other parent showed more response to nicotinic amide than to vitamin B_6. The roots of each line showed a characteristic morphology. It would appear that hybrid vigor is not limited to the top of the plant and that a study of the growth of excised roots of inbred parents and their heterotic offspring may throw light on the physiological basis for hybrid vigor.

Theoretical and experimental studies on protoplasmic streaming: WILLIAM SEIFRIZ and NOBURO KAMIYA (introduced by A. N. Richards). Protoplasm is often in active motion. In certain lowly plant forms, this motion, known as protoplasmic streaming, occurs in one direction only at a time. Reversal in direction of flow takes place rhythmically. The phenomenon is best illustrated in the slime molds. Hypotheses on the mechanism of protoplasmic streaming have been numerous. Surface tension, hydration, electroendosmosis and contractility are some of the forces which have been held responsible. The technique known as "time lapse" in cinematography has revealed a rhythmic pulsation of the plasmodium or body of a slime mold. The senior author regards this rhythmic contractility as the mechanism responsible for protoplasmic flow. The contraction and expansion of the plasmodium is perfectly synchronized with the outward and inward flow of the protoplasm. The theory is extended to include all forms of protoplasm. Rhythmic movements of tissues exist in virtue of the innate attribute of contractility in the protoplasm of which they are made. The chemical or physical basis of protoplasmic contractility is probably to be found in the contraction of folded protein molecular chains. The next step in our studies was the measuring of the motive force responsible for protoplasmic flow. The junior author set about to accomplish this. Through the development of a suitable technique it has been possible to oppose the force which moves protoplasm. A single strand is selected and so placed in a divided chamber that one half may be subjected to pressure while the other half is left unopposed. If, by this means, the protoplasm, where observed, is held still, the counter-pressure applied is a measure of the motive force responsible for streaming. The counter-pressure which is just sufficient to keep protoplasm quiet changes rhythmically. The range of this pressure, and therefore of the vital protoplasmic force, is between ± 25 cm of water. Instantaneous values of the balance pressure, taken every five seconds, and plotted against time, yield undulating curves which reveal such characteristics as frequency, amplitude and irregularities of the rhythm in protoplasmic activity. One of the most extraordinary of these is the presence of more than one rhythm: in short, protoplasm is a polyrhythmic system.

Formation of crystalline cellulose in plastids of living cells: WANDA K. FARR (introduced by C. B. Davenport). In 1934, uniform-sized, cellulose crystallites ($1.1\,\mu \times 1.5\,\mu$) were identified in cell membranes from various parts of the plant kingdom by means of microscopic, chemical and x-ray diffraction analyses. During the period of cell membrane formation these cellulose particles appear in the outer regions of the cytoplasm of a living cell, such as the cotton fiber, arranged end to end in orderly, single rows. The particles are coated with a viscous substance which holds them together to form the fibril and the fibrils, layer upon layer, to form the cell membrane. In the course of these earlier observations of the formation of plant cell membranes by cellulose particles and cementing substance elaborated in the protoplasm of living cells, no clue was obtained as to the mechanism of formation of the particles. The tropical marine alga, *Halicystis ovalis,* proved to be excellent material for the solution of this problem. Upon the inner surfaces of the membranes of its chloroplasts are formed, successively, rings of varying diameter and equal thickness. These rings fragment directly to produce the uniform-sized cellulose particles. In many types of cells of higher plants colorless plastids produce cellulose particles by essentially the same mechanism. In chlorophyll-containing cells of the higher plants, starch is formed in the chloroplasts and cellulose in separate plastids containing no pigment. Starch formation was observed in plastids of living cells before 1850. Cellulose formation has been more elusive and the mechanism which we now find in operation has been hitherto undescribed.

Observations on parasites and inclusion bodies in certain intestinal protozoa: DAVID H. WENRICH (introduced by C. E. McClung). Bacterial and fungoid parasites of Protozoa have been known for more than half a century. They were earlier seen in various kinds of free-living species, but during the past thirty years an increasing attention has been given to such parasites associated with endozoic Protozoa. Some of these associated organisms

are ectozoic and others are endozoic. Some may be symbiotic; for example, in the flagellate, *Lophomonas striata*, from the intestine of cockroaches, rods of the genus *Fusiformis* seem always to be present, persisting through division and encystment. Members of the genus, *Sphaerita*, considered to belong to the fungoid group, Chytridiales, are intracytoplasmic parasites, while members of the related genus, *Nucleophaga*, are intranuclear. Kirby (*Proc. Third Internat. Cong. for Microbiology*, 1940) has recently called attention to an extensive list of both ectozoic and endozoic forms associated with the Protozoa in termites. The present report is confined to associates of certain of the intestinal flagellates and amoebae of man and some other vertebrates. I have previously reported short oval rods adhering to the surface of *Trichomonas hominis* and of Diplococcus-like forms adhering to *T. vaginalis*. Short rods have recently been found on the surface of *T. augusta* and *T. batrachorum* in frogs and toads. In amphibian hosts, also, long slender rods are frequently found on the surface of *Monocercomonas* (*Eutrichomastix*) sp. and apparently the same kind on the surface of *Retortamonas dobelli* from the same hosts. Intracytoplasmic rods of various types have been found in trophic stages of *Chilomastix bettencourti* and trophic and cystic stages of *Giardia simoni* of rats and mice, and in *Trichomonas augusta* and *Chilomastix caulleryi* of amphibia. I have found species of *Sphaerita* in the flagellates, *Trichomonas muris, T. parva, T. minuta* and *Chilomastix bettencourti* (trophic and cyst stages), from rats and mice; in *Trichomonas augusta, T. batrachorum, Retortamonas dobelli, Hexamastix* sp. and *Monocercomonas* sp. from frogs and toads. I have also found members of this group in the parasitic amoebae, *Entamoeba coli* (trophic), *E. histolytica* (trophic and cyst), *Endolimax nana* (trophic and cyst), *Iodamoeba bütschlii* (trophic). There is evidence that there may be two species of *Sphaerita* in *T. muris*. There is also evidence that a flagellate may rid itself of parasites by detaching a blob of cytoplasm containing them from the posterior end. Evidence indicates that *T. augusta* also rids itself of parasites in the same manner. I have found intranuclear parasites, possibly belonging to the genus *Nucleophaga*, in *Trichomonas muris* and in the following amoebae: *Endolimax nana* (trophic and cyst), *Iodamoeba bütschlii* (cyst), *Entamoeba histolytica* (cyst), *E. muris* (trophic and cyst) and *E. ranarum* (trophic). Rather homogeneous inclusions have been seen in the cytoplasm of *Trichomonas muris, T. augusta* and *Chilomastix bettencourti* trophic stage. While these may be some special type of food or some unrecognized parasite, they are also similar to the intracellular inclusions of metazoa associated with filterable viruses.

Mating and metabolism in Paramecium calkinsi: EDGAR J. BOELL and LORANDE L. WOODRUFF. The respiration of two mating types of *Paramecium calkinsi* has been measured by means of the Cartesian diver technique in order to establish the normal rate of oxygen consumption for this species, and, in addition, to determine whether a physiological basis for the difference in mating behavior between the types can be discovered. The mating reaction in this species is represented generally by the formation of a clump ("agglutination") of large numbers of individuals of both types from which pairs of Type I and Type II animals then emerge. In animals in which the mating reaction consists of clumping with subsequent pairing, the average rate of oxygen consumption per animal per hour is 0.25 mμl for Type I and 0.28 mμl for Type II. This difference possibly is due only in part to a real metabolic difference between the types, since the average size of Type II animals is slightly greater than that of Type I. When the physiological state of the Paramecia is such that neither clumping nor pairing will occur, the oxygen consumption is much larger than when both of these phases of the mating reaction are manifest. The average respiratory rates for Type I and Type II animals are then, respectively, 0.43 and 0.48 mμl per animal per hour. Occasionally, the mating reaction consists only of the clumping phase—the mass of individuals then breaking up without the formation of pairs. In such cases, where clumping but no pairing occurs, the individuals of one type show the low rate of oxygen consumption characteristic of Paramecia which will both clump and pair, whereas the individuals of the other type respire at the typically high rate of animals in which mating tendency is absent. The results indicate that an inverse relationship exists between metabolic level and mating tendency and that clumping without pairing will occur between animals in which one type possesses a low rate of metabolism, while that of the other is high. Further evidence that clumping requires that a low metabolic level (and hence a positive mating tendency) exist in only one of the mating types is seen in the fact that clumping between living Paramecia of one type and a dead animal of the other sometimes occurs.

The composition of snake populations: EMMETT R. DUNN (introduced by D. H. Tennent). (1) Snake populations are made up of a few common species and a larger number of rare species. In general the commoner tenth of the species make up half the population; the rarer half of the species make up a tenth of the population. This relationship was first worked out for four areas in Panama, with snake faunas of many species, represented by some ten thousand individuals collected at random. It has been found to hold good as far north as California and Pennsylvania, and on faunas of as few as seven species. (2) The Panama areas each have a quite similar list of species, but a quite different list of dominant species. (3) The abundance of individuals in nature, as shown by the Panamanian statistics is not correlated with wideness of range of the species, number of species in the genus or number of genera in the family.

The primitive streak in embryos of the Macaque monkey: GEORGE L. STREETER. In embryos of the Macaque monkey, and probably of man and most mammals, the primitive streak is found to be in direct line from the primordial germ-plasm of the one-cell stage. In accepting the principle that development consists in proceeding from the more general to more specialized cells, the primitive streak is to be designated as the locus of the second

order of such specialization, the first being when the auxiliary elements of the egg separate themselves from the true formative elements. The primitive streak in a strict sense is not ectoderm any more than was the original one-cell egg. From it, however, the primary embryonic tissues known as ectoderm, mesoderm and endoderm are derived. This step constitutes a second order in specialization, and the derived cells are therewith limited in their potentialities to their particular types of development. That is to say, the primitive streak is not a defined embryonic tissue but constitutes what remains of the primordial mother cytoplasm, changed only in being drained of the specialized cells that are moving out and away from it to fulfil their various limited careers.

A single series vs. many pairs of sex factors in the wasp Habrobracon: P. W. WHITING (introduced by C. E. McClung). Snell (*Proc. Nat. Acad. Sci.*, 21: 446–453) postulated that sex differences might be determined by many pairs of independently segregating Mendelian factors. If the members of any one or more of the pairs were different, the wasp would be female: otherwise it would be male. It has now been shown that these factors do not occur in separate pairs, but in a single series (alleles). This has been done by tagging them with the gene causing fusion of antennal segments. The gene fused has been introduced into two stocks having different sex factors. In each stock the sex factors proved to be similarly linked with this gene. Therefore these sex factors must be in a single series.

Artificial mixing of incompatible germ-plasms in Drosophila: HERMANN J. MULLER. It has often been asserted that the differences between "good species" of animals, such as those which give sterile "mules" when crossed, are probably not Mendelian or chromosomal, and that the findings of geneticists therefore do not concern the more fundamental features of living things. As genetic analysis of such differences would require the obtaining of mixtures of various kinds—"recombinants"—that would only arise in the later generations of crosses between the two contrasted types, the impossibility of breeding the first generation hybrids has hitherto hindered a direct attack on the above problem. *Drosophila melanogaster* and *D. simulans* are examples of two such "good species," which in nature yield only sterile hybrids. We have found it possible to circumvent the difficulty inherent in this sterility, and to obtain and distinguish, in the first generation of this species cross, the types that would be characteristic of the second generation, derived from a back-cross between the sterile hybrids and pure *melanogaster*. The method involves the crossing of triploid *melanogaster* females, which produce eggs with some extra chromosomes, by x-rayed *simulans* males, which produce sperms with some incapacitated chromosomes. This situation provides opportunity for some of the offspring to receive two chromosomes of a given kind from one species and none of that kind from the other species, while at the same time, in the case of other kinds of chromosomes, they receive one chromosome from each species. Study of the different types thus produced gives evidence that those differences between these species which cause their hybrids to be sterile morphologically abnormal or inviable are dependent upon the properties of their chromosomes. The abnormalities can be analyzed into a series of effects, each of which results (as in Dobzhansky's crosses between different "races" of *Drosophila pseudoobscura*) from the inharmonious interaction of a factor or factors in a given chromosome derived from one species with another ("complementary") factor or factors in chromosomes from the other species. A "recombinant" female having all its major chromosomes from *melanogaster* and only minor chromosomes (the Y and one fourth) from *simulans* was normal and fertile—the only fertile hybrid—a result that verified the whole interpretation. By breeding this female the minor chromosomes were established in stocks which otherwise were purely *melanogaster*. It was found that in this *melanogaster* setting various genes of these minor chromosomes fail to act in precisely a normal manner. This supports our inference that the number of cryptic genetic differences between species far outrun those causing obvious differences between them or those working in a "complementary" way to cause abnormalities of their first-generation hybrids.

Cancer in catfish; pathology and transmission: BALDUIN LUCKÉ and HANS SCHLUMBERGER (introduced by Peyton Rous). Experimental cancer research has hitherto been done mainly with warm-blooded animals, because it has generally been thought that among the more primitive cold-blooded vertebrates, neoplasms are rare and consequently not readily available for investigation. However, a systematic search has revealed that various kinds of neoplasms, similar in structure and behavior to those in mammals and birds, are actually common among the lower vertebrates. Of such tumors one of the most suitable for studying certain phases of cancer is an epithelioma which frequently affects the catfish (*Ameiurus nebulosus*). During the past year the number of tumor-bearing fish obtained from streams in New Jersey and Pennsylvania has exceeded one hundred. This cancer usually occurs as a large, red, fleshy mass on the lips or the dental plates; less often it involves other parts of the mouth and rarely it extends to the skin. Sometimes the tumor becomes so massive as to prevent closure of the mouth. In approximately one third of the cases, a secondary tumor develops on that part of the opposite lip in direct contact with the primary growth. Histologically, the neoplasms consist of masses of epithelial cells which at first grow in an outward direction and show little tendency to invasion. But as the tumors become larger, they extend into adjacent tissues, and not infrequently they are seen to have pushed into vessels, where they form emboli. Experimentally, we have transmitted the neoplasm to fish of the same species by implanting it in the cornea of the eye, where it readily becomes established. The rate and mode of growth of the transplanted tumors have been followed over periods of several months by periodic examination of the living tumors. This was done by throwing a beam of light onto the

tumor, which was then observed through the transparent cornea with the microscope. It was thus learned that this cancer always develops according to a definite structural pattern, namely, in the form of undifferentiated membranes which gradually thicken and become more compact. In this manner growth continues until the tumor fills the cornea.

Cyclic changes in the mammary gland of the monkey: CARL G. HARTMAN and HAROLD SPEERT. A large and controversial literature has arisen concerning changes in the human breast in relation to the menstrual cycle. Since the phenomena accompanying the cycle in man and monkey parallel each other in so many respects; and since the monkey breast is so well adapted for study and is readily obtainable the matter was investigated in a series of nine regularly menstruating monkeys. It was found that there is a definite cycle when ovulation has occurred, none in the absence of ovulation. The chief changes consist of enlargement of the lobules and dilatation of the ducts. These changes begin to be manifest several days after ovulation and occur in accelerated tempo until they reach their maximum in the late premenstruum. The relation of these findings to the physiological action of estrogens and progesterone will be discussed.

The piezo-electricity of beta-quartz: A. W. LAWSON (introduced by D. W. Bronk). In distinction to the generally accepted belief that beta-quartz is not piezo-electric, the existence of piezo-electricity in quartz above 575° C., originally observed by Osterberg and Cookson, has been confirmed. Piezo-electricity was observed in small crystalline fragments of quartz up to about 800° C. by the "click" method. A suitably cut quartz bar was excited to longitudinal vibration which could be detected by both the click method and measurement of the impedance of the quartz with a peak voltmeter up to about 650° C. The observations suggest that the disappearance of piezo-electricity in beta-quartz at higher temperatures attributed by Osterberg and Cookson to the appearance of a new phase is due to the rapidly increasing electrical conductivity of the quartz.

Relative acid strengths in various solvents: MARTIN KILPATRICK (introduced by A. N. Richards). It has been shown experimentally that the ratio of the dissociation constants of the substituted benzoic acids to that of benzoic acid yields a sequence of relative acid strengths which differs from solvent to solvent. In general the meta and para substituted acids become relatively stronger in solvents of low dielectric constant while the reverse is true for ortho substituted acids. The effect of the meta and para substituents can be interpreted in terms of electrostatic effects, but the observed effect with decreasing dielectric constant is greater than the theoretical.

(To be continued)

OBITUARY

HENRY McELDERRY KNOWER

HENRY MCELDERRY KNOWER, son of Captain Edward C. Knower, U. S. A., and Mary D. (McElderry) Knower, was born in Baltimore, Maryland, on August 5, 1868. His death, at the age of 71, occurred in his native city on January 10, 1940. He was educated at schools in Baltimore and at the Johns Hopkins University, where he received the A.B. degree in 1890. Continuing there as a graduate student under the late Professor William K. Brooks, he was awarded the doctorate of philosophy in 1896. During this period he served as assistant for two years and the last year he held the Adam T. Bruce fellowship.

After obtaining his Ph.D. degree Knower was appointed to an instructorship in biology at Williams College but returned to Baltimore the following year and in 1899 became instructor in anatomy in the Johns Hopkins Medical School, where he remained ten years, the last year as associate. From Baltimore he was called in 1909 to the University of Toronto as lecturer in anatomy, and in 1910 he became professor and head of the department of anatomy at the University of Cincinnati. After his resignation from this post in 1924 he served as visiting professor at the University of Georgia (1925–27) and then as professor of anatomy at the University of Alabama until 1929. From 1930 to 1932 he was associate professor of anatomy in the Albany Medical College of Union University. His last appointment was that of research associate in biology at Yale University (1933–37).

In the late nineties Knower attended a number of sessions at the Marine Biological Laboratory, Woods Hole, and in 1908 became a regular summer resident. He served there as librarian from 1909 till 1919, during which period the library grew rapidly and was well arranged and catalogued.

In 1897 he married Miss Virginia Du Barry, who survives him. They had two children, Henry Du Barry, whose death late in 1939 was a severe blow to his father at a time when he himself was critically ill, and Virginia (Mrs. William A. Moore, of Bronxville, N. Y.). There are five grandchildren.

Knower's first research work dealt with the embryology of termites, in which he became interested on an expedition to Jamaica in 1891. This was the subject of his doctoral dissertation, which was published in Volume 16 of the *Journal of Morphology.* After his appointment in anatomy his interests naturally shifted to problems more closely related to that field. He became absorbed in the study of the development of the vascular system, first through the demonstration of the lymph hearts and vessels in embryos from which the systemic heart rudiment had been removed. In Dr. Mall's department during this period there was

much interest in the vascular system. Knower made essential improvements in the technique of micro-injection by blowing a bulb at the end of the capillary injector and using gentle heat, applied to the bulb, to propel the injection fluid. Through the years which followed he made extensive studies of the development of the vascular system, both blood vessels and lymphatics, and accumulated a vast collection of injected material, including embryos of various species of urodele and anuran amphibians and of fishes. Brief reports on this work were made from time to time at the meetings of the American Association of Anatomists, where his specimens were demonstrated, but it is only upon the anuran material that a full report was published, as one of the *American Anatomical Memoirs*. This was finished and put through press less than a year before his death, at a time when his physical condition was such that it seemed scarcely possible for him to work at all.

These investigations led to the conclusion that the lymphatics spread first from a center connected with the anterior lymph hearts, which pump the lymph into a tributary of the pronephric sinus. The process of growth is by budding, and in this Knower agrees with Hoyer, Sabin and Clark and is opposed to the lacunar theory. He did not reach this conclusion without careful consideration of the evidence, and, indeed, open-mindedness and critical judgment characterized all his work.

Knower will, perhaps, be remembered as much for his services in the establishment of the *American Journal of Anatomy* and the *Anatomical Record* as for his special investigations. At the close of the last century journals for the publication of anatomical and zoological research were altogether inadequate; in fact, aside from certain institutional publications, they were almost non-existent. On account of financial difficulties the *Journal of Morphology* had just been discontinued (fortunately only temporarily) and there was nothing to take its place. This was about the time when the Association of Anatomists was undergoing reorganization at the hands of a younger group of men who were active in anatomical research as understood in continental Europe. The need of a new journal was generally felt, but there was hesitancy about setting up any more institutional publications. Cooperative action was needed. Knower often discussed this situation with Mall, and late in 1900 determined to go ahead with the organization of the *Journal of Anatomy*. He visited various laboratories, secured pledges of financial support, and won the cooperation of the distinguished group of men that afterward formed the editorial board of the journal, which was nearly identical with the group that had been active in the reorganization of the association. When the editorial board was founded, Knower became its secretary, virtually managing editor, which position he held until 1921, when the ownership of the journal was transferred to the Wistar Institute. In those days the managing editor of a scientific journal was a combination of editor, business manager and office boy, and a lot of hard work was required to make the enterprise successful. Knower served with great devotion and tact, and this, together with the unselfish cooperation of the board, insured the success of the journal from the start. It is odd that he was never given the title of managing editor. Whatever may have been the reason, it was not lack of appreciation of his services. There are in his files many letters from members of the editorial board and from those who contributed funds for the journal, including President Daniel C. Gilman, that are most complimentary and appreciative. One of these, the last one written him by Dr. Charles Sedgwick Minot and dated June 26, 1914, announcing a grant from the Elizabeth Thompson Fund for Knower's research, may be quoted:

> We have from experience learned to look upon grants for illustrations as rarely desirable. In your case I explained to the Board that your University was probably not able to assist you much in that way but the deciding consideration was that you had done a great deal of devoted work for the Journal of Anatomy of the sort that necessarily receives little attention and excites none too much gratitude. The Board hopes that you will consider the grant partly as an expression of appreciation of your very real service in promoting the cause of Anatomy in America. It is a personal pleasure to me to write this to you.

The *Journal of Anatomy* naturally became the official organ of the Association of Anatomists, and some years later the need was felt for another type of publication that would bring out shorter articles, book reviews and news items of interest to anatomists, including the proceedings of the association. Thus was established in 1906, at Knower's initiation, the *Anatomical Record*, which was printed for the first two years as a supplement to the journal. During this period Knower, as editor, contributed frequently to its pages, but by 1908 it had made such a place for itself that it was established as an independent journal with its own editorial board.

As teacher and director of an anatomical institute Knower's main sphere of activity was at the University of Cincinnati. When he was called there in 1910, only a year after the publication of Flexner's report on medical education in the United States, two of the proprietary medical schools in Cincinnati had been united and had become affiliated with the university. The history of both schools went back many years to the days of Daniel Drake, and the rivalry between the two faculty groups continued after the merger.

The introduction of new ideas, especially in preclinical teaching and research, was needed, and Knower was one of a group of four men brought in from without to accomplish this purpose. The plans called for the construction of a complete new plant, both hospital and laboratories, which was carried through under the general leadership of the late Dr. Christian Holmes. Knower's part was to plan and equip the new anatomical laboratory, and this he did with vision and skill. He had brought with him from Baltimore the spirit of Mall's laboratory at Johns Hopkins, and this was reflected in the organization and atmosphere of the department. Such fundamental changes could not be carried through undisputed. Controversies that would not abate arose over methods of teaching, the value of research, and standards for students. Knower, always persistent and uncompromising in matters of principle, would not yield, and the friction that developed led in the end to his resignation, an occurrence which could and should have been avoided. Nevertheless, this transitional period was a constructive one, and in spite of the difficulties and the unfortunate ending it was a very happy one in his life.

Knower was one of those teachers who treated his students as individuals and not simply as members of a class. He was not a facile lecturer and the inspiration that he gave them was not through this medium. It was rather by close personal contact in the laboratory and by his sympathetic understanding of their problems that he won their warm regard and affection.

To his friends and associates he was loyal and true, companionable and sympathetic, with a sense of responsibility in all his relations. His humor, cheerfulness and good nature gained him many friends, especially among the younger generation. In his years of declining health, which were long and distressing, these qualities never failed him. His courage and determination in completing a substantial part of his life work during this period of adversity will remain as an example to all who knew him.

ROSS G. HARRISON

NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

RECENT DEATHS AND MEMORIALS

DR. CARL L. ALSBERG, director of the Food Research Institute and of the Giannini Foundation of Agricultural Economics at Stanford University, died on November 1 at the age of sixty-three years.

DR. JOHN RENSHAW CARSON, research mathematician at the Bell Telephone Laboratories, New York, died on October 31. He was fifty-four years old.

DR. ORMOND R. BUTLER, since 1912 professor of botany and botanist in the Agricultural Experiment Station of the University of New Hampshire, died on October 24 at the age of sixty-three years.

DR. WILLIAM GOGGIN CROCKETT, professor of pharmacy at the Medical College of Virginia, died on October 29 at the age of fifty-two years.

DR. GUSTAVUS AUGUST EISEN, from 1893 to 1900 curator of the California Academy of Sciences, known for his work in biology and archeology, died on October 29 at the age of ninety-three years.

THE REV. DR. JOSEPH J. WILLIAMS, professor of cultural anthropology at Boston College, died on October 28 at the age of sixty-four years.

DR. ROBERT BOWIE OWENS, electrical engineer, secretary of the Franklin Institute from 1910 to 1924 with the exception of the war years, died on November 2 at the age of seventy years. He was formerly director of the Bartol Research Foundation.

M. EDOUARD CLAPARÈDE, professor of psychology at the University of Geneva and permanent secretary of the International Congress of Psychology, died on September 2. During recent years he had specialized in child psychology and had established the J. J. Rousseau Corresponding Institute of France. He was an honorary member of the British Psychological Society.

DR. ADOLPHO LUTZ, of the Oswaldo Cruz Institute of Rio de Janeiro, author of medical, zoological and entomological works, died on October 6 at the age of eighty-four years.

THE W. S. Blatchley Club, formerly the Hamilton County Nature Study Club, held a memorial meeting on October 11 for the late Dr. Blatchley, formerly State Geologist of Indiana, for whom the club was named. The meeting was held at Noblesville and the memorial tribute was given by Dr. J. J. Davis, of Purdue University.

THE *Journal* of the American Medical Association states that friends of the late Dr. Lawrason Brown, for many years head of the Trudeau Sanatorium, Saranac Lake, N. Y., have established the Lawrason Brown Memorial Fund to finance one or more fellowships for research in diseases of the chest. The fund will be managed by the Saranac Lake Society for the Control of Tuberculosis, and if at any time that organization should cease to exist the management of the fund will be offered first to the Johns Hopkins University. The present committee is composed of Drs. Leroy U. Gardner and James Woods Price, Saranac Lake; Louis Hamman, Baltimore; Esmond R. Long, Philadelphia; David R. Lyman, Wallingford, Conn., and William P. Thompson, New York.

SCIENTIFIC EVENTS

THE U. S. WEATHER UNIT AT HARVARD

THE United States Weather Bureau on November 1 moved its headquarters for regular observing of the sun's radiation from Washington, D. C., to the Blue Hill Meteorological Observatory of Harvard University, in Milton, Mass.

Two government technicians and government solar observation equipment will henceforth be located at the Harvard station. Weather bureau instruments for solar observation will be calibrated at the Harvard station, and the routine solar reports of other government observatories will be received and edited there.

Harvard's observatory has been carrying on study of the intensity of solar radiation for eight years, initiated by Dr. Herbert H. Kimball, research associate, who retired from the government Weather Bureau in 1932, and from Harvard last year.

Solar observations made at the Harvard weather station include measurement of the intensity of solar radiation on a horizontal plane and on a plane perpendicular to the sun's rays, and also study of the dust and moisture content of the atmosphere. The observations are important in weather forecasting and also for increasing knowledge about the sun and the earth's atmosphere.

Professor Charles F. Brooks, director of the Harvard weather station, explains that in moving solar observation headquarters to the Harvard station the government weather officials considered both the advantageous observing conditions on Blue Hill, relatively free from city smoke; and also the intensive studies of solar radiation being carried on in this region by both Harvard and Massachusetts Institute of Technology under the auspices of foundations established by Dr. Godfrey L. Cabot, Harvard, 1882, of Boston.

The government technicians at Blue Hill will be Irving F. Hand and Mrs. Helen Cullinane, now of the Washington Bureau.

THE CANAL ZONE BIOLOGICAL AREA

A MOVE to put the research laboratory on Barro Colorado Island on a permanent basis was successful when the act was passed directing the President of the United States to set aside within the Canal Zone an area in Gatun Lake known as Barro Colorado Island in which the natural features shall, except in event of declared national emergency, be left in their natural state for scientific observation and investigation, the area to be known in the future as the Canal Zone Biological Area. The act provides for a Board of Directors to consist of the Secretary of War, the Secretary of Agriculture, the Secretary of the Interior, the Secretary of the Smithsonian Institution, the president of the National Academy of Sciences and three distinguished biologists appointed by the president of the National Academy of Sciences with the approval of the Secretaries of War, Agriculture, Interior and the Smithsonian Institution; the president of the academy to be chairman of the board and the secretary of the Smithsonian Institution to be vice-chairman. The Act also authorized an appropriation not to exceed $10,000 each year as a contribution toward the expenses of running the laboratory.

Since the passage of the Act three biologists, Dr. Thomas Barbour, director of the Museum of Comparative Zoology at Harvard College; Dr. Elmer D. Merrill, director of the Arnold Arboretum of Harvard University, and Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution and director of the U. S. National Museum, have been appointed members of the board as provided by law, the President of the United States formally carrying out, under an Executive Order, the direction of Congress setting aside the Canal Zone Biological Area.

The first annual meeting was held on October 7 and the next annual meeting will be held on May 1, 1941.

THE LALOR FOUNDATION

THE Lalor Foundation has announced the program of its fifth series of fellowship awards in chemistry for the academic year 1941–42. Four post-doctorate awards of a value of $2,000 each and two awards of $2,500 each have been authorized. They are open to both men and women. The recipient of an award must have the equivalent of a Ph.D. degree and the applicants will be judged by their previous training, demonstrated competence and promise in their special fields of work.

The six fellowship awards have been assigned one each to the following chemists notable for their leadership in research: Dr. Roger Adams, University of Illinois; Dr. Hans Clarke, Columbia University; Dr. Frederick G. Keyes, the Massachusetts Institute of Technology; Dr. Charles A. Kraus, Brown University; Dr. Arthur B. Lamb, Harvard University; Dr. E. K. Marshall, the Johns Hopkins University Medical School. Each of these men will have the responsibility for selection of the holder of the award at his respective institution.

Detailed information and application forms may be obtained by addressing C. Lalor Burdick, secretary of the Lalor Foundation, Wilmington, Del., or by direct communication with the above-named men. Applications should be filed before December 31. Appointments will be announced early in 1941.

THE ADMINISTRATION OF THE E. R. SQUIBB AND SONS AWARD

IN order to promote interest in researches dealing with endocrinology, E. R. Squibb and Sons have established an annual award of $1,000 to be given through the medium of the Association for the Study of Internal Secretions. The association, through an appropriate committee of judges selected from its membership, will name the recipient of this award; the formal presentation of it will be made as part of the annual meeting program.

The award will be given to the research worker in the United States or Canada who, in the opinion of the judges, has published during the previous calendar year the most meritorious scientific report dealing with the field of the hormones. While it will be given primarily for publication of specific papers, the judges will be given considerable latitude in the exercise of their function. If in their judgment circumstances and justice so dictate, it may be recommended that the prize be divided between two or more persons. It may also be recommended that it be made to a worker for valuable contributions over an extended period but not necessarily representative of a given year. Membership in the association is not a requisite of eligibility for the award.

A committee of judges consisting of five members of the association will be appointed annually by the president to recommend to the council a recipient for the award. To assist this committee in its deliberations nominations will be solicited by the secretary of the association by means of public announcements and by a note in the annual letter to members. Such nominations may be sent to the secretary at any time for transmissal to the Committee of Judges. For a nomination to be considered for the award to be bestowed at any given spring meeting of the association, however, it must be received by the secretary not later than January 15. The nomination should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee in its consideration of the nomination. In addition to the investigation of the merit of nominations thus made, it will be the duty of the committee to search the literature on its own account in arriving at its selection of a recipient for the award. The personnel of the committee will be kept confidential until its deliberations are finished.

The name of the nominee selected by the committee should be sent to the secretary of the association as soon as possible after January 15. This nomination will then be submitted to the council for ratification and thereafter the nominee will be notified in order that he may make plans for being present at the annual meeting. The name of the nominee will be kept confidential by all concerned until the announcement is made at the annual dinner, at which time the award will be bestowed by the president of the association. The recipient will be expected to make a brief response.

It is a very definite desire of both the donor and the council that the award be made annually. In accepting the award, the council specified that the field covered should be broad enough so that there should be no question about finding a meritorious contribution and recipient annually. It is understood, however, that the association will not be expected to make the award for definitely mediocre work. Thus, the council is prepared to consider the withholding of the award in any given year if it is the carefully considered judgment of the committee that this should be done.

In addition to the purse provided by E. R. Squibb and Sons the recipient will be presented with a simple scroll as a memento of the occasion, the cost to be defrayed by the association.

THE PERMANENT SCIENCE FUND OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

INCOME from the Permanent Science Fund, according to agreement and declaration of trust, shall be applied by the American Academy of Arts and Sciences to such scientific research as shall be selected ". . . in such sciences as mathematics, physics, chemistry, astronomy, geology and geography, zoology, botany, anthropology, psychology, sociology and economics, history and philology, engineering, medicine and surgery, agriculture, manufacturing and commerce, education and any other science of any nature or description, whether or not now known or now recognized as scientific, and may be applied to or through public or private associations, societies, or institutions, whether incorporated or not, or through one or more individuals."

Applications for grants are considered by a committee of this academy on stated dates only. The next meeting to consider applications will be held on February 15, 1941. Applications should be made on special forms furnished by the committee. Correspondence, including requests for application blanks, should be addressed to the chairman of the Committee on the Permanent Science Fund, Professor John W. M. Bunker, the Massachusetts Institute of Technology, Cambridge, Mass. Grants-in-aid from this fund were voted by the academy on October 9, as follows:

To Lloyd R. Watson, professor of chemistry, Alfred University, New York, for expendable materials and for assistance in a continuation of his study of eye colors of mutant bees, $450.

To Edward H. Kemp, assistant professor of psychology, Duke University, for rebuilding an amplifier system to be used in recording impulses from single fibers of the eighth nerve, $250.

To Dr. Daniel Abramson, assistant in obstetrics, Boston Lying-In Hospital, for chemicals, animals and other expendable materials to be used in a study of the effect of "Relaxin" on smooth muscle, $300.

To Lyman G. Parratt, assistant professor, Cornell University, for equipment and construction of high voltage apparatus for a continuing study of the outer energy levels of solid materials, $325, contingent upon receipt by the recipient of a similar sum from the Rumford Committee or elsewhere.

To Charles W. Turner, professor of dairy husbandry, University of Missouri, for the purchase of experimental animals and feed for a study of the relation of thyroid gland to the fat, carbohydrate and protein metabolism hormones of the anterior pituitary, $500.

To George E. Valley, Jr., national research fellow, Harvard University, for machine work, metal stock, materials and specimens required in his study of the energy and relative intensity of gamma rays from certain atomic nuclei, $450.

To Donald H. Menzel, professor of astrophysics, Harvard University, for the purchase of quartz plates and other materials to construct filters for isolating narrow bands of light to be used in astronomical studies, $450.

To Alfred C. Lane, professor emeritus of geology, Tufts College, to supply certain materials and assistance to Professor Wahl, of Helsinki, Finland, as a part of the program of the Committee on the Measurement of Geological Time of the National Research Council, $250, provided that means can be found to forward materials and funds to the above destination.

To Alvin L. Moxon, experiment station chemist, South Dakota State College, Brookings, South Dakota, for materials and animals to be used in his investigation of the antagonism between arsenic and selenium as it relates to selenium poisoning of livestock, $300.

To Martin D. Whitaker, instructor of physics, New York University, a final grant for the rental of a radium beryllium source to continue his investigation in slow neutron scattering which was supported from this fund in the calendar year just completed, $500, contingent upon the applicant's ability to secure $350 from some other source.

To Hugh M. Huffman, assistant professor of biochemistry, California Institute of Technology, for construction of a semimicro bomb to be used in his continuing studies of the application of thermodynamics to physiological processes, $400, contingent upon his assurance that funds will be available for the remainder of the cost of the problem outlined by him.

To James A. Beattie, professor of physical chemistry, of the Massachusetts Institute of Technology, a final grant for materials and construction of a cryostat to cover the temperature range 0° to −270° C. to be used in his studies in the absolute temperature scale from −270° to +450° C., $500.

THE CHEMICAL EXPOSITION

AN Industrial Chemical Conference will be held in connection with the National Chemical Exposition from December 11 to 15 at the Stevens Hotel in Chicago. At this conference new discoveries and developments in the service of chemistry and its application and progress in many fields of activity will be discussed.

Announcement is made that the directors of the exposition, sponsored by the Chicago Section of the American Chemical Society, believe that its objectives may be enhanced by furnishing the latest scientific information as well as the practical education that will result from a visit to the exhibition.

Dr. R. C. Newton, chairman of the exhibition committee, states:

> We have arranged for this Industrial Chemical Conference an excellent program of papers in the nature of symposia on "Newer Developments in Chemistry and Chemical Engineering." The program is timed to afford those who wish to hear the talks in which they are interested ample opportunity also to view the show.

Technical sessions for the conference have been arranged for Thursday afternoon and evening, December 12; Friday morning, December 13, and Saturday afternoon, December 14. The regular monthly meeting of the Chicago Section of the American Chemical Society will be held on Friday evening, December 13.

Dr. Newton states that in addition to speakers there will be a number of new films shown on a variety of subjects. It is planned to set aside a room for the frequent showing of films that should be of interest to those attending the exposition.

The committee estimates that approximately 40,000 chemists will attend the exposition and conference, including chemists, chemical engineers, operating engineers, production managers, plant superintendents, buyers and company executives. Exposition floor space is limited to 38,000 square feet, more than 75 per cent. of which has already been assigned.

SCIENTIFIC NOTES AND NEWS

THE Sedgwick Memorial Medal of the American Public Health Association has been awarded posthumously to Dr. Hans Zinsser.

THE American Geographical Society has awarded the Cullum Geographical Medal to Dr. Robert Cushman Murphy, curator of oceanic birds at the American Museum of Natural History, and the Charles P. Daly Medal to Professor Carl O. Sauer, chairman of the department of geography at the University of California. The presentation will be made at a meet-

ing of the society to be held in New York on December 20.

THE John Fritz Medal for 1941 has been awarded to Ralph Budd, president of the Chicago, Burlington and Quincy Railroad, for "the improvement of railroad tracks and service, especially the introduction of light-weight streamlined trains." The medal was established in 1902 in memory of John Fritz, who had distinguished himself in improving methods for the manufacture of steel. The board of award is composed of sixteen representatives of the four national societies of civil, mining and metallurgical, mechanical and electrical engineers. The medal will be presented to Mr. Budd at a dinner late in December or early in January.

AT a joint meeting in Urbana, Ill., on November 9, of the Midwest, Central and Cincinnati Sections of the American Association of Cereal Chemists a presentation will be made to Past President George Garnatz, of the Kroger Food Foundation, for his year of service in office. The national president, Claude Davis, of the Noblesville Milling Company, will describe Mr. Garnatz's work, after which Dr. C. H. Bailey, of the University of Minnesota, will make the presentation. Dr. J. H. Shollenberger, of the Northern Research Laboratory of the Department of Agriculture, will speak on "Production and Utilization Aspects of the Wheat Situation."

DR. WILLIAM J. KERR, professor of medicine in the School of Medicine of the University of California, formerly president of the American Rheumatism Association, has been elected an honorary member of the Liga Argentina contra el Reumatismo of Buenos Aires.

THE *Journal* of the American Dental Association reports that at the annual meeting in Cleveland on September 10 the entire day was set aside as "Harvey J. Burkhart Day" in honor of Dr. Burkhart, director of the Rochester, N. Y., Dental Dispensary and of the Eastman Clinics in Europe. Dr. Burkhart was guest of honor at a luncheon in the Hotel Statler, attended by more than a thousand colleagues and friends.

DAVID KEYNES HILL, the son of Dr. A. V. Hill, Foulerton research professor of physiology and secretary of the Royal Society, London, has been elected a fellow of Trinity College, Cambridge, in recognition of his research in physiology.

OFFICERS of the Society of American Bacteriologists have been elected as follows: *President,* Dr. M. L. Isaacs, professor of sanitary science at Columbia University; *Vice-president,* Dr. Edw. J. Keegan, of the department of bacteriology of St. Johns University; *Secretary-treasurer,* Dr. Carroll Grant, professor of bacteriology at Brooklyn College; *Councilor,* Dr. Nicholas Kopeloff, professor of bacteriology at Columbia University.

DR. NORMAN H. CEAGLSKE, of the State University of Iowa, has been appointed assistant professor of chemical engineering at Washington University, St. Louis.

EDWIN D. MCKEE, naturalist of the Grand Canyon National Park and a research associate of the Carnegie Institution of Washington, has been appointed director of the Museum of Northern Arizona. He will join the museum staff on January 1.

FREDERICK G. SWITZER, professor of mechanics and hydraulic engineering and head of the department of mechanics in the Sibley School of Mechanical Engineering of Cornell University, has resigned to become a division engineer with the New York City Board of Water Supply. He will be succeeded at Cornell by Dr. James N. Goodier, who joined the faculty in 1938 as professor of mechanics.

A. M. BUSWELL, professor of chemistry at the University of Illinois, has been appointed the representative of the American Chemical Society on the advisory committee of the U. S. Public Health Service for the Revision of Drinking Water Standards.

DR. J. BURNS AMBERSON, JR., professor of medicine at the College of Physicians and Surgeons, Columbia University, has become a member of the committee on medical education and of the committee on medical research of the National Tuberculosis Association.

ASSISTANT PROFESSOR D. W. KERST has leave of absence from the department of physics of the University of Illinois until September, 1941, for the purpose of developing his induction accelerator in the research laboratory of the General Electric Company.

DR. FREDERICK S. HAMMETT and the statistical staff of the Lankenau Hospital Research Institute will be located at Fiddlers Point, Grenada, Sarasota, Florida, for the winter. The mail address is P. O. Box 347, Sarasota, Fla.

JOSEPH F. ROCK has resigned from a position as research associate in the University of Hawaii because of dissatisfaction on his part with facilities for storage and display of his collection of Chinese books and art objects, some of which had been presented conditionally to the university and the remainder deposited on indefinite loan. Because of his feelings in the matter, the collection has been released to him. He has now returned to China to continue his studies of ancient manuscripts on which he has been working for some years.

THE *News Edition* of the American Chemical So-

ciety states that G. C. Crooks, assistant professor at the University of Vermont, secretary of the Western Vermont Section of the society, has been granted leave of absence in order to accept a call to active duty in the Chemical Warfare Service. For the present he will serve as liaison officer between the offices of the Assistant Secretary of War and the Adjutant General of the State of Vermont.

THE second Barnard Hospital lecture will be given on November 19 by Dr. Carl Voegtlin, chief of the National Cancer Institute, in the auditorium of the St. Louis Medical Society. His subject will be "Possibilities of Improved Therapy for Cancer Patients."

DR. ANDREW C. IVY, Nathan Smith Davis professor of physiology and pharmacology and head of the department at the Medical School of Northwestern University, will give the eighth E. Starr Judd lecture at the University of Minnesota on January 15. The subject of the lecture will be "The Mechanisms of Gastric Secretion."

PROFESSOR JOHN T. BUCHHOLZ, head of the department of botany at the University of Illinois, gave a Graduate College lecture at the State University of Iowa on October 14 on "Genetics of Pollen-tube Growth in *Datura*."

THE Salmon Memorial Lectures will be delivered at the New York Academy of Medicine on the evenings of November 8, 15 and 22 by Dr. Nolan D. C. Lewis, director of the New York Psychiatric Institute and Hospital and professor of psychiatry at Columbia University. The titles of the individual lectures are "Historical Perspectives of Psychiatric Thought," "Modern Ramifications in Psychiatric Thought and Research" and "Prospects for Future Achievement in Psychiatric Research."

THE Hume Cronyn Memorial Observatory of the University of Western Ontario, London, was dedicated on the afternoon of October 25. Greetings from sister observatories and universities were conveyed by Dr. C. A. Chant, director emeritus of the David Dunlap Observatory of the University of Toronto, and by Dr. S. A. Mitchell, director of the Leander McCormick Observatory of the University of Virginia. At the convocation exercises held the same evening, Professor Mitchell was awarded the degree of doctor of laws and gave the address entitled, "Astronomers and Their Telescopes."

APPLICATIONS for the Benjamin Peirce instructorships in mathematics at Harvard University for the year 1941–42 should be sent to the chairman of the department of mathematics. Candidates should have received the doctorate or have done equivalent work.

THE endowment of the Arnold Arboretum of Harvard University has been increased by two recent bequests amounting to $35,932. Of this, $12,880 was from the estate of Miss Grace L. Edwards, and $23,054 from the estate of Mrs. James G. Freeman, the latter to be added to the Laura Lucretia Case Fund.

THE General Education Board has added $12,700 to the grant previously made to the Brush Foundation of the School of Medicine of Western Reserve University for the study of child health and development under the direction of Dr. William Walter Greulich, professor of physical anthropology and anatomy and director of the foundation.

THE Rockefeller Foundation has given £1,000 to the Royal Society of Medicine for the preservation of its library. It is proposed to evacuate to a suitable house a number of the older and irreplaceable periodicals. A member of the library staff will accompany them and will be in telephonic communication with the library in London.

THE University of California at Los Angeles has undertaken to train meteorologists for the U. S. Weather Bureau, the United States Navy and the United States Army. Fellowships are being offered by the Government to students of graduate standing. The work in meteorology will be offered under the direction of Dr. J. Bjerknes, formerly of Bergen, Norway, and Dr. J. Holmboe, of the Massachusetts Institute of Technology. Additional courses in thermodynamics, mathematics, mechanics and astrophysics will also be offered in the program.

SIXTY-FIVE educational institutions have been accredited for chemistry instruction by the Committee on the Professional Training of Chemists of the American Chemical Society, of which Professor Robert E. Swain, of Stanford University, is chairman. The list includes only those institutions of which the committee has been able to make a careful study up to the present time. According to the report, the need for more thorough training in chemistry not only in academic work but in control, development and research in the chemical industries has become particularly apparent in the last two decades. During the depression, the striking fact, of utmost importance to the chemical profession, was uncovered that a large proportion of those in the list of unemployed chemists did not qualify, by training or experience, to hold chemical positions. The American Chemical Society is striving to improve the profession of chemistry. It is fundamental to such a program that the training and experience necessary for a man who is to be called a chemist to be recognized and at least in broad terms specified.

THE *E. W. Scripps,* the research vessel of the Scripps Institution of Oceanography at La Jolla, is

now in the Gulf of California on a three-months scientific cruise. The trip is sponsored jointly by the University of California and the Geological Society of America. Its object is to study the sediments and geology of the bottom of the gulf. Four principal areas will be investigated in detail and soundings will be taken at other points. Dr. Francis P. Shepard is a member of the expedition.

THE American Association of Dental Editors, composed of the editorial staffs of non-proprietary dental journals, is considering a plan to develop means for the abstracting of all articles published in their respective journals. They propose that the editors of individual dental journals agree to furnish and pool abstracts of all articles which they publish. These will be offered to some large group, such as the American Dental Association, for publication.

ACCORDING to *Nature* the Geographical Department of the Northern Sea Route Administration (USSR) has sent out the icebreaker *Sedov* on a new expedition to the northeastern part of the Kara Sea. It will be remembered that the *Sedov* returned to Murmansk on January 29, 1940, after a remarkable drift in the Arctic of twenty-seven months duration. The head of the new expedition is V. I. Vorobyev. The purpose of the expedition is to study one of the most important parts of the Northern Sea Route in the Kara Sea—from Izvestia Tsik Islands to Russky Island. The total length of this part is about two hundred nautical miles. The expedition is to carry out hydrographic and hydrological research: it will make systematic soundings of the depths of the sea, study the currents, wind régime, ice conditions and will carry out magnetic observations.

DISCUSSION

ON THE THEORY OF THE SEPARATION OF ISOTOPES BY THERMAL OR CENTRIFUGAL METHODS

THE theory of the separation of the components of a fluid by the thermal process has been discussed in detail by Waldmann, Furry, Jones and Onsager and Debye.[1] The importance of the process has been greatly enhanced by the striking success of its use in the separation of the isotopes of the elements. With this success has come a demand for a more complete knowledge of the functioning of the apparatus for a greater variety of types of gas flow than vertical thermal convection; the calculations of the investigators, mentioned above, were limited to this case. With the realization that similar processes are applicable to the centrifugal method,[2] it seemed that the same general method which will be described in detail in this paper for the thermal case could be applied profitably to that very interesting problem. The results of the calculations for both these cases will be compared in this note. However, the conclusions will be restricted to those systems which have been in operation for a period of time sufficiently long that they have nearly reached a state of equilibrium. For simplicity, a two-dimensional system will be considered in which the mass motion in the fluid is in the direction of the z-axis, and in which the primary effect, either thermal diffusion resulting from a temperature gradient between the walls, is in the x-direction, or that diffusion resulting from a centrifugal field gradient, is radial in the r-direction. It will be convenient to consider a fluid composed of two components with masses m_1 and m_2 and with concentrations c_1 and c_2 respectively. For the thermal case the equation of equilibrium can be expressed, for example, for the first component in the form

$$-\rho v \frac{\partial c_1}{\partial z} + \rho D \frac{\partial^2 c_1}{\partial z^2} + \frac{\partial}{\partial x}\left[\rho D\left(\frac{\partial c_1}{\partial x} - \alpha \frac{c_1 c_2}{T}\frac{\partial T}{\partial x}\right)\right] = 0 \quad (1)$$

in which the second term

$$\rho D \frac{\partial^2 c_1}{\partial z^2}$$

can be dropped if the total change in the concentration of the first component is small compared to its initial concentration. This equation is subject to the boundary condition that at $x=0$ and $x=d$,

$$\frac{\partial c_1}{\partial x} - \alpha \frac{c_1 c_2}{T}\frac{\partial T}{\partial x} = 0$$

and that the net flow across any plane perpendicular to the z-axis is zero, *i.e.*,

$$\int_0^d (\rho v)\, dx = 0, \text{ for all values of } z. \quad (2)$$

To complete the mathematical formulation of the problem the equation must be added which expresses the condition that across any plane perpendicular to the vertical axis the transport of component, one, resulting from diffusion and mass motion must be in equilibrium.

$$0 = \int_0^d \rho\left(-D\frac{\partial c_1}{\partial z} + v c_1\right) dx$$

for all values of z. To the approximation that all changes in c_1 are small compared to its initial value this equation gives for a column of height, h,

$$\frac{\Delta c_1}{h} D \rho_0 d = -\int_0^d \int_0^x \rho v\, dx \left(\frac{\partial c_1}{\partial x}\right) dx \quad (3)$$

[1] Waldmann, *Zeits. f. Physik*, 114: 53, 1939; Furry, Jones and Onsager, *Phys. Rev.*, 55: 1083, 1939; Debye, *Ann. d. Physik*, 56: 284, 1939.

[2] Beams and Skarstrom, *Phys. Rev.*, 56: 266, 1939. U. S. Patent Application, ser. no. 263352, 1939.

where ρ_o is the average density of the medium. Now the equation for thermal diffusion can be written to a first approximation as

$$\rho_o D \frac{\partial c_1}{\partial x} = \rho_o D \alpha \frac{c_1 c_2}{T\,av.} \frac{\Delta T}{d} - \frac{\Delta c_1}{h} \int_o^x (\rho v)\, dx \qquad (4)$$

where ΔT is the temperature difference between the walls and T *av.* is the average temperature of the enclosure. The substitution of (4) in (3) gives for the thermal case

$$\frac{\Delta c_1}{h} = \frac{-\frac{\alpha c_1 (1-c_1)}{\rho_o D d^2} \frac{\Delta T}{T\,av.} \int_o^d \int_o^x \rho v\, dx.\ dx}{1 + \frac{1}{\rho_o^2 D^2 d} \int_o^d ([\int_o^x \rho v\, dx]^2) dx}$$

as the equation for the determination of the total change in concentration Δc_1, along the column.

This equation has a number of simple properties: (1) For any given distribution of ρv consistent with equation (2) the value of Δc_1 can be determined by quadratures. (2) The total change in concentration varies directly as the height h of the column. (3) The change in concentration Δc_1 for a column of fixed height h has a maximum value for a definite value of d, the width of the column. For the case where the mass motion is that of thermal convection, *i.e.*,

$$\rho v = \rho_o v_o \frac{x}{d} (x - d/2)\ (d - x)$$

the position of the maximum computed in this way agrees to within 3 per cent. with Waldmann's value. (4) The last two results are well known. The new and interesting conclusions concern the changes produced in these results by varying the character of the vertical mass motion such as may be accomplished by the appropriate use of baffels or other suitable mechanical means.[3] For the same transport of fluid across one half of the transverse section of the apparatus, the maximum in the value of Δc_1 as a function of d, occurs for certain velocity distributions at a smaller value of d—besides that the maximum value of Δc_1 is greater—the closer the maximum values of the velocity occur to the boundary $x = 0$ and $x = d$. (5) Similar results to those stated above in (1), (2) and (3) can be calculated for a centrifuge operating at a frequency f with an appropriate mass motion of the fluid circulating in the direction of the axis of rotation of length h. The type of gas motion seems to be rather critical as these calculations show that not all types of circulation in the direction of the axis lead to an appreciable increase in the separation factor. Some idea of the relative optimum operation of the thermal and centrifugal separator respectively can be gained by comparing the relative values of the maximum of $\Delta c_1/h$ as a function of the width d. As the width d of the centrifuge is defined the effective radius. For these two distinct types of apparatus the ratio of the maximum of $\Delta c_1/h$ is as the ratio of the static effects. By static effect is meant the change in concentration arising from either thermal diffusion or centrifugal diffusion without any accumulative effect from the circulation in the fluid. It is interesting to note, however, that the calculations predict that for the centrifugal case the transport of fluid across one half of the transverse section of the apparatus, such as may be produced by thermal means in a centrifuge of proper pitch, should be nearly the same per unit area as that of the thermal separator with the circulation produced by thermal convection when both apparatuses are operating under optimum conditions, with the same values for the pressure of the gas and the width of the apparatus.

ARTHUR BRAMLEY

WASHINGTON, D. C.

[3] Brewer and Bramley, *Jour. Chem. Phys.*, 7: 972, October, 1939; Bramley and Brewer, *Jour. Frank. Inst.*, March, 1940 (Bartol Notes).

THE STANDARDIZATION OF OSMOTIC PRESSURE AS A TERM

IN physical chemistry osmotic pressure has a long-established meaning: a physico-chemical property of a solution. Any definitions of osmotic pressure should not conflict with this. Confining ourselves to aqueous solutions we may say that osmotic pressure measures the difference of the fugacity of water between that in pure water and that in water acting as the solvent in a solution. This difference in fugacity is more or less proportional to the solute concentration, so that this difference, and hence the osmotic pressure, increases with increasing solute concentration. Osmosis is diffusion of water. Water diffuses from regions of high water fugacity (pure water) to regions with lower water fugacity (solution). Hydrostatic pressure is enhanced in turgid cells; an increase in hydrostatic pressure increases the fugacity of water, *e.g.*, vacuolar water. Since this pressure increases water fugacity the difference between the fugacity of water in the solution under pressure and that of free pure water is diminished and the effective or actual osmotic pressure is also diminished. Cells in water equilibrium have no residual actual or effective osmotic pressure, although the same fluid under no excess pressure would have the osmotic pressure given by its composition. This view obviates the desire for such terms as suction pressure. Suction pressure is the residual effective osmotic pressure when the cell contents are under pressure insufficient for equilibrium.

The definition proposed by Eyster[1] seems to consider that some quantity parallel to fugacity of water should be termed osmotic pressure. He says, "The osmotic

[1] H. C. Eyster, SCIENCE, 92: 171, 1940.

pressure of water in the vacuole of a plant cell is increased by turgor pressure and decreased by the solute concentartion of the cell sap." But physical chemistry, the underlying discipline, teaches that pressure (including turgor pressure) *decreases* the osmotic pressure of solutions, while increased concentration *increases* it.

It is to be hoped that botanists generally will recognize the perfectly clear relations furnished by physical chemistry.

S. C. BROOKS

UNIVERSITY OF CALIFORNIA

EQUINOXES AND SOLSTICES

ACCORDING to SCIENCE of September 13, 1940, any implication that the equinoxes and the solstices mark the beginnings and the ends of the seasons riles Professor Sleator, of the University of Michigan, up one side and down the other. He reminds one of the Iowa farmer who "cussed" for a month on receiving by express from a Scotchman a yearling sheep when he had ordered a fine hog. Of course the ruckus between these two honest men was all because to the one "hog" meant a grown-up pig, and to the other a grown-up lamb. So it is with the term "summer." As commonly used it means, even to the astronomer, the warmest season of the year, without, though, a definite time for either beginning or ending as defined by statute or set by common agreement. If, however, we so divide the year into four approximately equal periods that one shall be as much as possible the warmest of all, and call it summer, then throughout most of the northern hemisphere summer would roughly coincide with the three months which together there generally are called summer, namely, June, July and August. The like months in the southern hemisphere, are, of course, December, January and February.

But all this, though sufficient for our everyday needs, is lacking in precision. It does not have that satisfying exactness that pertains to each of the four quarters of the year proposed by astronomers more than two thousand years ago, that is, the periods delimited by the equinoctial and solstitial instants—the two times when the center of the sun is in the plane of the earth's equator and the two times when it is farthest therefrom. One of these periods, the one that runs from about the 22nd of June to the 23rd of September, astronomers call the summer quarter, or summer, for short. Here, as in so many other cases, the scientist just took a loosely used everyday word and changed it into a technical term by giving to it a meaning that is exact, however much or little it may differ from that of the original.

To say that summer begins at the moment of summer solstice and ends at the moment of autumnal equinox is to talk in the same breath astronomical good sense and agricultural nonsense. What, then, shall we do about it? Nothing. So long as it sounds newsy to say that summer began at such or such a particular hour and minute of a certain night, for instance, the papers will just keep on saying it that way. It is up to the reader, as we say, to recognize the fact that the summer in question is not the vaguely determined period in which the local vegetation flourishes, and therefore different for different regions, but that exact period which the astronomer has arbitrarily called summer.

When buying a hog, sight unseen, be certain what sort it is, sheep or pig. Similarly, when we read of summer beginning at a certain minute on the 22nd of June, we have only to remember that this is summer in the technical sense, as the astronomer defines it, and not summer as we personally experience it. Perhaps, though, the annual repetition of this confusion by the papers is not a bad thing, after all, for it does afford occasions for spreading a bit of interesting astronomical information at times when it is likely to be welcome.

W. J. HUMPHREYS

U. S. WEATHER BUREAU,
WASHINGTON, D. C.

REFERENCE CITATIONS AND MICROFILM

THE value of the Bibliofilm Service of the U. S. Department of Agriculture and the Medicofilm Service of the Army Medical Library to the worker located away from large libraries is well known. One using such service soon realizes that certain methods of listing references are more useful than others, both to the worker and to the microfilm service.

The best type of reference cites the author, year, title, journal, volume, first and last pages. Some journals omit the title or the last page or both. Usually the nature, and consequently the desirability, of a paper can be determined by the title. Also, omitting the title results in the wrong article being copied if the page listings are in error. If the last page number is omitted, the length of the article can not be determined. It is valuable to know the length of the article for two reasons: (1) the decision can be made as to whether it is to be copied on microfilm or photostated; (2) the correct amount of money to cover the copying cost can be sent with the order, thereby simplifying the accounting. It is realized that complete listing of references might involve a small additional expense for some journals, but this should be more than offset by the increased value to the reader.

MARTIN D. YOUNG
G. ROBERT COATNEY

U. S. PUBLIC HEALTH SERVICE

SCIENTIFIC BOOKS

PROGRESS BY COOPERATION

The New Systematics. Edited by JULIAN HUXLEY. 583 pp. Oxford University Press. $6.00.

A GROUP of the best British cytologists, ecologists, geneticists and taxonomists convened in June, 1937, in Burlington House, London, in the rooms of the Linnean Society and founded an "Association for the Study of Systematics in Relation to General Biology" under the presidency of Julian S. Huxley.

The society, recognizing that the supremacy of the morphological methods in taxonomy had lasted long enough, aimed to bring together a large group of general and taxonomic biologists to study, not only how recent advances and discoveries in various branches of general biology could further taxonomy, but also how taxonomy could reciprocate this help (". . . daring the reproaches of his biological colleagues the taxonomist maintains that his subject is the alpha and has the potentiability of becoming the omega of a very considerable part at least of biological knowledge"—Turrill).

Many of the opinions expressed by the founders of the society are hardly original, most of them had been said better and years ago in Scandinavia and Germany. Yet the founding of the society may well be a milestone in the history of biology as it represents the first *large-scale organized cooperative effort* to get away from old-fashioned outlooks and methods in taxonomy.

The following list of chapters may give an idea of the scope of the society's first book:

W. B. TURRILL: Experimental and synthetic plant taxonomy (simple cultivation under approximately uniform conditions; under varied but controlled or known conditions; cytological experiments; genetical experiments).

N. W. TIMOFEEFF-RESSOVSKY: Mutations and geographical variation.

C. D. DARLINGTON: Taxonomic species and genetic systems (the role of structural change; the decay of sexual reproduction; genetic isolation; hybridity, phylogeny; etc.).

SEWALL WRIGHT: The statistical consequences of Mendelian heredity in relation to speciation.

H. J. MULLER: Bearings of the "Drosophila" work on systematics.

LANCELOT HOGBEN: Problems of the origins of species. ("There is no one problem of the origin of species. There are many problems of the origins of species.")

E. B. WORTHINGTON: Geographical differentiation in fresh waters with special reference to fish.

C. DIVER: The problem of closely related species living in the same area. ("The aim of taxonomy is more than the mere pigeon-holing of different organisms on some convenient but completely arbitrary system of card-indexing. It seeks to establish relationships, and to determine what degree of dissimilarity is consistent with placing two individuals within the same species.")

E. J. SALISBURY: Ecological aspects of plant taxonomy (interesting conclusions, *vide* pp. 358–361).

W. H. THORPE: Ecology and the future of systematics.

G. R. DE BEER: Embryology and taxonomy. ("Two little embryos in spirit, whose names I have omitted to attach, and at present I am quite unable to say to what class they belong. They may be lizards or small birds, or very young mammalia.")

W. J. ARKELL and J. A. MOY-THOMAS: Palaeontology and the taxonomic problem. ("The question 'What constitutes a species?' always so troublesome to the neontologist, hardly concerns the palaeontologist, since the more he learns of phylogeny the more arbitrary must be the distinctions he draws between his species. He is, in fact, torn between two irreconcilable endeavours; for as a phylogenist he strives to reveal closer and closer relationships, while as a systematist he must point out differences and divide up his material into units bearing distinct names.")

J. RAMSBOTTOM: Taxonomic problems in Fungi (summary of special mycological problems, p. 412).

T. A. SPRAGUE: Taxonomic botany, with special reference to the Angiosperms.

W. T. CALMAN: A museum zoologist's view of taxonomy. ("What is very remarkable and significant, however, in this constant influx of novelties, is the rarity of the unexpected. The diversity is indeed unending, but it runs in well-defined channels.")

J. S. L. GILMOUR: Taxonomy and philosophy. ("A number of questions connected with the theoretical side of their work which are by no means satisfactorily settled and . . . . these points of disagreement are frequently a hindrance to progress in taxonomic practice.")

JOHN SMART: Entomological systematics examined as a practical problem. ("Steps should be taken to prove the worthiness of systematics for recognition as a discipline by the academic world. The present objection to recognition would, possibly, be largely removed if systematists showed genuine signs of adopting real rational and scientific methods for the coordination and recording of their information, and the prosecution of their work. It is possible that these findings may have an application to a wider field than Entomological Systematics alone.")

E. B. FORD: Polymorphism and taxonomy.

H. H. ALLAN: Natural hybridization in relation to taxonomy.

M. B. CRANE: The origin and behaviour of cultivated plants. ("The taxonomist has generally regarded the study of cultivated plants with suspicion. He has tended, possibly on account of a false philosophical distinction between natural and artificial conditions, to ignore all cultivated plants as outside his discipline or as forming a secondary applied branch of it, namely, economic botany. The geneticist, on the other hand, following Darwin's example, has found convenient and useful material in cultivated plants and domestic animals, with their wealth of analysable varieties and frequent high fecundity in crosses.")

N. I. VAVILOV: The new systematics of cultivated plants. ("We regard classical systematics, which works only with Linnean species, as merely a first step in biological knowl-

edge and quite superficial for the purposes of practical plant and animal breeding. Nor does it satisfy the requirements of a thorough study of species from an evolutionary point of view. We are now entering an epoch of differential, ecological, physiological and genetic classification. It is an immense work. The ocean of knowledge is practically untouched by biologists. It requires the joint labors of many different specialists—physiologists, cytologists, geneticists, systematists and biochemists. It requires the international spirit, the cooperative work of investigators throughout the whole world.'')

DR. JULIAN HUXLEY, who edited the book, contributed a general introductory chapter, often critically summarizing the essential contents of subsequent chapters.

"The New Systematics" is the society's first large cooperative publication. It is not a manual that will help a young taxonomist anxious to start working along new lines with as simple indications as the morphologists and anatomists of one or two generations ago found in Strasburger or Chamberlain. It is much more a collection of discussions and essays which one will have to read, reread and compare to make the best use of. Most of us taxonomists, feeling as we all do that our methods resemble more those of the bibliographer than those of the accurate experimental scientist, will gladly make this effort and will be rewarded by discovering a volume as inspiring as Linné's "Philosophia" and De Candolle's "Phytographie." Yet it carries another message. Linné (eighteenth century) taught us new methods of investigation and description; De Candolle (nineteenth century), in addition to these, new methods of documentation. The message of this twentieth century book is that taxonomy is going to be a field of cooperative research. This is important news for all who take the future of American science to heart, for nowhere in the world at present are conditions so suitable for large-scale cooperative research as in the New World.

The book shows better than any similar recent publication how the old taxonomist, who preferred the company of plants to that of men—the interesting figure of a generation ago, whose love for the *scientia amabilis* resulted very often from a desire to escape human society, will have to make place for another type of scientist anxious to cooperate and to organize collaboration with and between workers in many branches of general biology.

Julian Huxley on his last visit to this country urged the foundation of a society similar to the British society. May this book in the States be a stimulus to bring American taxonomists and general biologists closer together.

FRANS VERDOORN

FARLOW HERBARIUM,
HARVARD UNIVERSITY

SPECIAL ARTICLES

A CANCEROGENIC TISSUE EXTRACT FROM HUMAN SOURCES[1]

AN extract has been prepared from the livers of persons who died of cancer which on subcutaneous injection into mice produced sarcomas at the site of injection.

In one experiment 9,420 grams of liver obtained from eight cases were extracted. These people had carcinoma of the stomach (three cases), carcinoma of the lung (two cases), carcinoma of the esophagus, pancreas, and rectum (one case of each). There were no carcinoma metastases visible in the livers grossly or microscopically.

The livers were ground and preserved in an equal volume of 95 per cent. alcohol. They were then saponified with alcoholic KOH for 24 hours in a steam bath, a volume of water equal to that of the alcohol in the mixture being added. The material was then extracted repeatedly with ethylene dichloride. This extract was evaporated to dryness at reduced pressure and the residue was resaponified. The final unsaponifiable residue so obtained was a flaky brown material with a disagreeable odor.

This residue was dissolved by warming with sesame oil. The oil has been tested repeatedly, unheated and after heating, and found not to be cancerogenic. About half a gram of extract dissolved in .5 cc of sesame oil was injected subcutaneously in 56 mice on June 1, 1939. The test of the potency of the extract was by no means quantitative because great but variable amounts were lost by sloughing at the site of injection. The mice used were of our own albino stock. They were of both sexes and were from 55 to 83 days old at the time of injection. Over two thousand mice of this stock have been used in a series of long-time experiments and a spontaneous spindle cell sarcoma has never been observed in them. The stock carries a small incidence of spontaneous mammary gland tumors, lymphatic diseases and lung tumors.

The first tumor appeared between five and six months after injection, and the mouse died on December 7, 1939, 182 days after injection. The tumor was large, measuring $33 \times 25 \times 22$ mm. It lay in the subcutaneous tissues and infiltrated the underlying muscle and overlying skin. It had not metastasized. Microscopically it was a spindle cell sarcoma, which resembled the sarcomas induced by the common carcinogens.

At this time 37 of the original 56 mice were living. Some of these quickly developed tumors, so that at

[1] This work was aided by a grant from the National Advisory Cancer Council.

the end of 16 months, 13 tumors have appeared, and 7 mice are still alive without visible tumors. The number and rate of death with tumors is shown in Table 1.

TABLE 1

Time in months	Living mice	Dead with tumors
0	56	0
5	45	0
6	42	0
7	37	1
8	34	4
9	32	6
10	21	7
11	20	8
12	15	10
13	13	12
14	10	12
15	8	13
16	7	13

These tumors are all spindle or polymorphous cell sarcomas. One has shown metastases to the lungs. They grew rapidly after they first appeared, killing the animals in about three weeks. Much of the injected extract was seen in the subcutaneous tissues. Although it was injected dorsally in the interscapular region part of it gradually migrated to the lateral and even ventral subcutaneous tissues. The sarcomas appeared to arise directly in this orange or brown material, and in two mice multiple, apparently independent, sarcomas were found surrounded by the extract.

Attempts at transplantation were made with three tumors from different mice. Although the recipients were not of a highly inbred stock and the number of animals used was small (five to six) transplantation was successful with two of the three tumors. Serial transplantation was then carried through the fourth transplant generation when it was permitted to die.

Control experiments of several kinds have been made:

Control A. Livers from seven persons who died of a variety of non-neoplastic diseases were extracted in exactly the same way. This nonsaponifiable residue has induced no tumors. The experiment was an exact duplicate of that just described except that the amount injected at one time was only half as large (about 250 mg), but a second injection of the same size was made sixty-five days afterward. Thus the total amount injected was approximately the same, namely 500 mg. The dose was divided in an attempt to reduce sloughing with loss of the extract. Sixty-three mice were originally injected, of which fifty-two are alive and without tumor 220 days after the first injection.

Control B. The non-saponifiable residue from 7,970 gm of carcinoma tissue has failed to induce tumors in experiments identical with those of the livers from cancer patients. In this experiment one injection of .5 gm of extract was made. Thirty-four mice are alive at the end of fourteen months and are without tumor.

Control C. The non-saponifiable residue from 18,435 gms of cancer tissue has failed to produce tumors in mice. These tissues had been fixed by the Kaiserling method before the saponification was made. The cholesterol was also removed from the residue before injections were made. In this experiment an initial injection of 250 mg of the non-saponifiable residue was made into each mouse on December 29, 1939, followed by injections of 100 mg on February 23, 1940, 100 mg on March 25, 1940, and 100 mg on April 22, 1940. Nine months after the first injection thirty mice are living without tumor. The total dose of 550 mg is relatively larger than that used in the other experiments because most of the cholesterol had been removed from this extract.

The results of the control experiments B and C are of interest in view of the experiments recently announced by Menke.[2] By the use of fat solvents he obtained extracts from human mammary gland carcinomas which have induced one tumor in each of two experiments.

Schabad reported the production of tumors by a benzene extract of a liver from a patient with primary carcinoma of the stomach.[3] Heiger has confirmed these results according to Cook,[4] and who gave no details.

A benzene extract of a liver from a case of carcinoma of the stomach has not yielded any tumors in our laboratory, although a total 2.5 cc of the extract was injected in five doses over a period of sixteen weeks. Twenty-six mice lived for six months after the first injection, twenty-one lived for eight months, and nineteen lived for nine months without developing tumors at the site of injection.

It appears then that the non-saponifiable residue of the livers of persons who had cancer, the livers not being involved, contain substances which are cancerogenic for mice. Although sufficient time has not lapsed to permit final conclusions, to date a similar extract from the livers of non-cancer bearing persons has not induced tumors. Similarly, by this method of preparation, cancer tissues themselves did not yield cancerogenic substances.

Experiments are in progress on the chemical separation, on the relation to the type of cancer, on the distribution within the body and on the origin of the substance.

NOTE: The author is indebted to Dr. Carl Marberg, who suggested the method of chemical procedure, and supervised the preliminary chemical work.

PAUL E. STEINER

UNIVERSITY OF CHICAGO

[2] John F. Menke, SCIENCE, 92: 290, 1940.

[3] L. M. Schabad, *Compt. rend. Soc. de Biol.*, 124: 213, 1937.

[4] J. W. Cook, E. L. Kennaway and N. M. Kennaway, *Nature*, 145: 627, 1940.

RADIOACTIVE CARBON AS A TRACER IN THE SYNTHESIS OF PROPIONIC ACID FROM CO_2 BY THE PROPIONIC ACID BACTERIA

RECENT investigations[1,2] using radioactive carbon C^{11} and the stable isotope C^{13} on CO_2 uptake by the propionic acid bacteria during the dissimilation of glycerol have demonstrated that the carbon from CO_2 is distributed between the two major products, namely, succinic and propionic acids. The equimolar ratio between CO_2 uptake and succinic acid formation has led to the hypothesis that the succinic acid is formed through the addition of CO_2 to a 3-carbon intermediate, thus yielding the 4-carbon compound.[1,2,3] Accordingly, succinic acid should contain labelled carbon (C^*), which was found to be the case;[1] this was confirmed and extended to show that the labelled carbon was present only in the carboxyl groups of the succinic acid.[2] From this evidence it did not appear unreasonable that labelled propionic acid was derived from the succinic acid via decarboxylation.

In a continuation of our earlier studies we have investigated this hypothesis from two aspects, using radioactive C^{11} (half-life of 21 minutes). If propionic acid originates via succinic acid, then labelled succinic acid supplied to the bacteria in the presence of glycerol and inactive bicarbonate should yield labelled propionic acid through loss of one of the carboxyl groups. Furthermore, according to this hypothesis the propionic acid should contain labelled carbon only in the carboxyl group. We have tested this by preparing and separating radioactive propionic and succinic acids using propionic acid bacteria; these labelled acids were re-introduced separately into fresh bacterial suspensions in the presence of inactive CO_2 and glycerol. The fermentation in the presence of the labelled acids was allowed to proceed for 60 to 90 minutes. No convincing evidence for the reaction succinic acid $\rightleftarrows$ propionic acid was found under these conditions.

Decarboxylation of the radioactive propionate to oxalate and carbonate was effected by alkaline $KMnO_4$ oxidation at 100° C. for 30 minutes. The extent of the decarboxylation was followed by two methods, *viz.*, radioactive and gravimetric, with excellent agreement between the two. From 70 to 75 per cent. of the radioactivity was found in the oxalate fraction and 25 to 30 per cent. in the carbonate. The presence of C^* in both the oxalate and carbonate fractions from the oxidation of the propionate suggests the presence of C^* not only in the carboxyl group of the propionic acid but also in the α and/or β positions of the aliphatic chain. It is likely, however, that in the $KMnO_4$ oxidation of the propionate the carbonate liberated is not always the original carboxyl. Thus radioactive oxalate may be obtained from propionate containing C^* only in the carboxyl group. In order to obtain more conclusive evidence for the uniform distribution of the C^* within the propionic acid a dry distillation (at 350° C.) of labelled barium propionate was carried out which yielded labelled barium carbonate and diethyl ketone. If C^* was present only in the carboxyl group then 50 per cent. of the radioactivity would be found in each of the products; if C^* was uniformly distributed then 83.4 per cent. should be in the ketone and 16.6 per cent. in barium carbonate. Experimentally 88 per cent. was found in the ketone and 12 per cent. in the barium carbonate. In addition radioactive CHI_3 was obtained from the $(C_2H_5)_2CO$ by oxidation with I_2 in alkaline solution. In view of these results it seems reasonable to conclude that all the carbons in the propionic acid are labelled, although by the latter method it is not possible to distinguish between the α and β carbons. However, since two thirds of the C^* is found in the oxalate fraction ($KMnO_4$ oxidation), it would appear that all the carbon atoms of propionic acid may originate from CO_2. While it does not necessarily follow that any one molecule of propionic acid is synthesized completely from CO_2, it appears that the net reaction:

$$\begin{matrix} CH_2OH & CH_3 \\ CHOH & \rightarrow CH_2 + H_2O \\ CH_2OH & COOH \end{matrix}$$

proceeds in part through a reduction of carbon dioxide to propionic acid by glycerol. A comparison of the amount of labelled propionic acid with total propionic acid formed by the bacteria during the experiment, as determined by chemical analysis, shows that 5 to 10 per cent. of the total carbon of propionic acid formed originated from C^*O_2. From these experiments a rather unexpected conclusion is reached, namely, the two main products of the glycerol fermentation, propionic and succinic acids are not formed via each other. It seems that an appreciable fraction of the propionic acid has been synthesized from C^*O_2 rather than from a simple transformation of glycerol without degradation of the carbon skeleton. In other words, CO_2 is reduced to propionic acid with an organic compound (in this case glycerol) acting as the ultimate reducing agent. The reduction of CO_2 by all living cells (photosynthetic and non-photosynthetic) for synthesis of cellular constituents or excretory products[4,5,6] is strongly supported by the present findings. This reduction of CO_2 may proceed to a greater or

[1] S. F. Carson and S. Ruben, *Proc. Nat. Acad. Sci.*, 26: 422, 1940.

[2] H. G. Wood and C. H. Werkman, *Jour. Biol. Chem.*, 135: 789, 1940.

[3] H. G. Wood and C. H. Werkman, *Biochem. Jour.*, 34: 129, 1940.

[4] S. Ruben and M. D. Kamen, *Proc. Nat. Acad. Sci.*, 26: 418, 1940.

[5] H. A. Barker, S. Ruben and J. V. Beck, *ibid.*, 26: 477, 1940.

[6] A. J. Kluyver, *Suomen Kemistilehti*, 12-A: 81, 1939.

lesser extent, depending on the biological system involved, and may require special conditions.

We have also carried out some experiments on the fermentation of pyruvic acid by the propionic acid bacteria. During this fermentation carried out in the presence of C^*O_2 a relatively large amount of the fixed C^* was found in the form of a carbonyl compound, precipitable as a 2,4 dinitrophenylhydrazone along with pyruvic and oxalacetic acid present as carriers. The possibility of this compound being an α-keto acid with C^* in the carboxyl group is strongly suggested by the enzymatic decarboxylation of the radioactive compound with yeast carboxylase, in which C^*O_2 was obtained. Radioactive propionic and succinic acids were also formed in this fermentation. Details of these and other experiments will be published elsewhere.

We are indebted to Professor C. B. Van Niel and Professor H. A. Barker for much valuable advice and discussion. We wish to thank Professor E. O. Lawrence and members of the Radiation Laboratory for their cooperation.

S. F. CARSON
J. W. FOSTER[7]
S. RUBEN
M. D. KAMEN

HOPKINS MARINE STATION OF
STANFORD UNIVERSITY,
DEPARTMENT OF CHEMISTRY AND
RADIATION LABORATORY OF THE UNIVERSITY
OF CALIFORNIA AT BERKELEY

MASSIVE "ACUTE" PRECIPITATION OF FREE SULFATHIAZOLE IN THE URINARY TRACT*

THE formation of concrements in the urinary tract after chronic administration of sulfanilamide derivatives has been reported repeatedly in the literature.[1, 2, 3] The uroliths were always found to contain a high percentage of the very insoluble *acetylated* form of the different compounds. After administration of sulfapyridine or sulfamethylthiazole the concrements were located mainly in the renal pelves, ureters and bladder, whereas, after sulfathiazole administration, considerable intrarenal precipitation (in the collecting tubules) was observed.[4]

In the course of an investigation on the acute intraperitoneal toxicity, in rats and mice, of the 3 derivatives[5] mentioned above, the peculiar observation was made that all animals dying from a single dose of sulfathiazole or its sodium salt, without exception, showed massive precipitation of the *free* drug in the urinary tract. Depending upon the dose, and consequently upon the time-interval between injection and death of the animal, the precipitate was found in different parts of the urinary tract. If death occurred only a few hours after the injection, the collecting tubules and the papillary ducts were filled with a whitish material distinctly visible macroscopically and extending into renal pelves, ureters and bladder. After a longer time-interval, the precipitate in the kidneys diminished in amount and finally disappeared (usually after 24 hours), while the bladder became completely filled and even distended with a white crystalline material, which in some cases reached back into the lower parts of the ureters. Within 10 to 20 hours this soft precipitate in the bladder was converted into hard aggregates weighing between 5 and 30 mg and composed almost entirely of free sulfathiazole. If the animals survived for at least several hours, anatomical signs of irritation were often found in the kidneys (marked enlargement with congestion and edema).

The picture as described in the different stages was seen in 54 rats and 20 mice injected with various doses of sulfathiazole or its sodium salt.

This phenomenon of acute precipitation was further investigated by sacrificing groups of 3 rats at different time-intervals after the intraperitoneal injection of a sublethal dose of sodium sulfathiazole (1.0 g/kg). The urinary tract was examined carefully and drug determinations in blood and various tissues were performed. Some of the results are summarized in Table I.

TABLE I

DETERMINATION OF SULFATHIAZOLE

Time after injection	Blood		Kidney				
	mg. per cent.		mg. per cent. per moist tissue		Total amount in both kidneys in mg.		Gross precipitation in the renal papilla
	Free	Acetyl.	Free	Acetyl.	Free	Acetyl.	
5 min.	103	0	145	0	2.12	0	0
15 min.	101	0	259	0	4.32	0	±
30 min.	115	0	396	0	6.06	0	++++ massive
60 min.	107	0	322	0	5.06	0	+++
3 hrs.	58	0	266	25	4.96	0.46	++
12 hrs.	44	7	67	27	1.76	0.70	+
24 hrs.	10	5	17	9	0.32	0.18	0

Intraperitoneal injection of sodium sulfathiazole 1.0 g/kg in rats. All figures are the mean of the values from 3 animals.

It can be seen from the table that precipitation (composed entirely of *free* sulfathiazole) reaches its maximum in the renal papilla 30 minutes after the

[7] National Research Council Fellow.

* Aided by a grant from the Sidney C. Keller Research Fund.

[1] W. Antopol and H. Robinson, *Proc. Soc. Exper. Biol. and Med.*, 40: 428, 1939; *Arch. Path.*, 29: 67, 1940.

[2] P. Gross, F. B. Cooper and M. Lewis, *Proc. Soc. Exper. Biol. and Med.*, 40: 448, 1939.

[3] H.Molitor and H. Robinson, *Proc. Soc. Exper. Biol. and Med.*, 41: 409, 1939; *Arch. internat. de pharmacodyn. et de therap.*, 62: 281, 1939.

[4] P. Gross, F. B. Cooper and R. E. Scott, *Urol. and Cutan. Review*, 44: 205, 1940.

[5] D. Lehr, W. Antopol, J. Churg and H. Sprinz, *Proc. Soc. Exper. Biol. and Med.* In press.

intraperitoneal administration and disappears completely within 24 hours. Acetylation becomes apparent at about 3 hours after the injection. The deposition of relatively increasing amounts of the extremely insoluble acetylated derivative may be responsible for the renal irritation.

The data presented demonstrate the extreme rapidity of absorption and excretion of sulfathiazole and lend further support to the view which has been expressed elsewhere: that the acute precipitation in the urinary tract is due mainly to a high rate of elimination of sulfathiazole from the body. Thus after concentration of the glomerular filtrate by reabsorption of water, precipitation occurs in the collecting tubules.

A similar picture could not be produced with sulfanilamide, sulfapyridine, sulfamethylthiazole or their sodium salts.

DAVID LEHR
WILLIAM ANTOPOL
JACOB CHURG
THE NEWARK BETH ISRAEL HOSPITAL,
NEW JERSEY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFICATION OF RIDDLE'S METHOD OF PROLACTIN ASSAY

WHILE we were comparing the alkaline alcoholic extraction method of Bates and Riddle[1] with the acid acetone extraction method of Lyons[2] for preparing lactogenic hormone of the anterior pituitary, it became necessary to use a large number of pigeons for accurate assaying of various fractions used in the investigations.[3] The purchasing and keeping of the pigeons, however, became so expensive that a way had to be found to reduce the cost as much as possible. The method described below is the result of such an attempt and enables one to assay the hormone without sacrificing the birds. Thus the cost of investigation was greatly reduced.

As in the original method of Riddle, Bates and Dykeshorn,[4] we used both male and female pigeons. On the previous day, before the injection of the sample, the feathers on the pectoral regions of the birds as well as on the area around the crop sac on the neck are carefully plucked. Before the injection of the sample, the skin layer over the crop sac on either right or left side of the median line is incised to the length of about two centimeters, so that the crop sac can be clearly seen. The crop sac is usually colorless and transparent and the presence of food material such as wheat, oats and barley within the sac is clearly discernible. If the crop sac is opaque and thick as in the nesting and nursing period, the pigeon is not suitable for the assay of the hormone and should be exchanged for another bird. Only the pigeons with clear transparent sac are used for the assay. After examination of the sac, the opening is closed by sewing with surgical suture and an appropriate antiseptic, such as tincture of iodine or merthiolate solution, is applied. As in the original method, a definite quantity of the sample solution is injected once daily for four days. On the fifth day (ninety-six hours after the first injection) the crop sac located on the other side of the one previously examined is exposed and examined. According to the condition of the thickening of the sac membrane, the potency of the hormone solution is evaluated.

The method is easy to execute with a little practice. It should be borne in mind, however, that the examination of the sac should be made as soon as it is exposed. The irritating operations such as rubbing of the exposed area with alcohol-soaked cotton swabs or cheesecloth must be avoided, since a slight irritation of the crop sac membrane will result in the thickening of the membrane and may cause an erroneous evaluation of the potency of the sample. It is important to note that during the incising of the skin layer over the sac, great care should be exercised to avoid tearing the crop sac membrane. If, however, the crop sac membrane is cut, the area should be immediately closed by holding together the surrounding membrane and tying with sterile silk thread.

After the examination of the sac, the incised skin layer is closed by sewing with surgical suture and an antiseptic is applied. The pigeon is then kept in a large cage for three to four weeks or until the incised area is perfectly healed. They are then ready to be used again for prolactin assay.

The authors are aware of the fact that an accurate assaying of the hormone by this method or any other biological method is a difficult task. This is due to the variation in the sensitivity of the individual birds, even among the same strain.[1,2] The difficulty can be overcome if a large number of birds are used for the assay of a sample and also by using a standard preparation for comparison as recommended by Bates and Riddle or by the Commission on Biological Standardization of the League of Nations. The authors believe that by the use of the method described here and with

[1] R. Bates and O. Riddle, *Jour. Pharm. Exp. Therap.*, 55: 365, 1935.
[2] W. R. Lyons, *Proc. Soc. Exp. Biol. and Med.*, 35: 645, 1937.
[3] The results of the study will be published in the *Journal of Biochemistry* (Japan).
[4] O. Riddle, R. Bates and S. W. Dykeshorn, *Amer. Jour. Physiol.*, 105: 191, 1933.

the use of a standard preparation, a great deal of saving will be accomplished without sacrificing the accuracy of the assay.

NAO UYEI
MASAO ITOH
SEIJI HAYATSU
FUKUJU UYENO

TEIKOKUSHA HORMONE RESEARCH INSTITUTE,
KAWASAKI-SHI, JAPAN

CELLOPHANE COVER SLIPS AND A METHOD FOR MOUNTING

BECAUSE the price and paucity of cover glasses used in the preparation of microscope slides have become almost prohibitive of their use, an efficient, economical substitute has been sought. O'Brien and Hance[1] have stated that isobutyl methacrylate may be used to replace the cover. This has not been found practical when slides are produced in large numbers. The solution seems also to detract from the brilliancy of the stain. Suntzeff and Smith[2] recommend a plastic, cellulose acetate, obtained in sheets the approximate thickness of No. 1 cover glasses. They experience some difficulty in its use because the plastic tends to curl unless the slides are carefully dried at room temperature for five to six days.

Plain transparent Cellophane[3] has been used in our laboratory during the past seven months. Cellophane covers have a refractive index of 1.53, dry rapidly and without curling, are very thin and inexpensive. Cellophane can be obtained in rolls 15/16ths inch wide, slightly less than the width of a slide. Strips of the desired length are cut as needed. No. 300 plain Cellophane seems to be most satisfactory. It is .00088 inch (0.022 mm) thick. (No. 1 cover slips average 0.13 mm in thickness.) It is possible to take photomicrographs from slides having Cellophane covers. Oil immersion does not affect Cellophane but for high magnifications replacements with glass covers may prove desirable.

The only difficulty so far encountered in the use of Cellophane as a substitute for glass cover slips has been the storage of the roll. During the winter months it can be kept at ordinary room temperatures, but under more humid conditions the Cellophane absorbs moisture, the edges of the roll wrinkle and will not lie smoothly. This wrinkling can be avoided by storing the roll of Cellophane in a desiccator, but continued storage over a long period causes warping and cracking.

Moistureproof Cellophane is less susceptible to atmospheric changes, but it too will wrinkle, and does not seem to be quite as clear as the plain. Cellulose acetate[4] No. 88 was tried, but was found not to adhere to the slide when dry. This is probably caused by the xylol used to mount the covers.

A method long used for mounting glass covers is successful with Cellophane as well. Instead of leaving the slides to dry in trays they are turned face down on clean paper towels and xylol is pipetted between them. An extra towel on top readily absorbs any excess on the back of the slide. In 15–30 minutes the slides are ready for use. This method has several advantages: (1) it insures a thin layer of mounting medium under the cover, (2) the slides are ready for immediate use. Further drying in an oven is entirely unnecessary, (3) it removes any excess mounting medium, leaving the edges and ends of the slide clean and dry. Canada balsam was first used in this manner but since the appearance of an article by Groat[5] we have used Clarite exclusively. It dries more rapidly than balsam, is clear and adheres well to Cellophane.

IRENE BUCHOLTZ

STATE UNIVERSITY OF IOWA

[1] O'Brien and Hance, SCIENCE, 91: 412, 1940.
[2] Suntzeff and Smith, SCIENCE, 92: 17–18, 1940.
[3] A du Pont product obtained through H. D. Catty Distributing Company, 3311 Carroll Avenue, Chicago, Illinois.
[4] Courtesy of du Pont Company.
[5] R. A. Groat, *Anat. Record*, Vol. 74, No. 1, 1939.

BOOKS RECEIVED

ALLEN, PAUL W. and GEORGE M. CAMERON. *Microbiology Laboratory Manual.* Pp. 243. Illustrated. Mosby. $2.00.

Boletim do Museu Nacional. Vol. XII. Numero 3–4. Setembro-Dezembro, 1936. Pp. 138. Illustrated. *Vol. XIII. Numero 1–2. Marco-Junho, 1937.* Pp. 313. Illustrated. *Vol. XIII. Numero 3–4. Setembro-Dezembro, 1937.* Pp. 175. Illustrated. Museu Nacional, Rio de Janeiro.

Carnegie Institution of Washington. *Publication 514, Contributions to Paleontology; Studies of Cenozoic Vertebrates and Stratigraphy of Western North America.* Pp. 194. Illustrated. $3.25. *Publication 518, Contributions to Embryology, Vol. XXVIII, Nos. 170 to 178.* Pp. 451. Illustrated. $5.00. The Institution.

CROXTON, FREDERICK E. and DUDLEY J. COWDEN. *Applied General Statistics.* Pp. xxv + 944 + xiii. Illustrated. Prentice-Hall. $4.00.

D-G Biology Test Sheets. Loose-leaf. Illustrated. Denoyer-Geppert. Chicago.

GETMAN, FREDERICK H. *The Life of Ira Remsen.* Pp. 172. Illustrated. Messner. New York. $3.00.

GUDGER, EUGENE W., Editor. *The Bashford Dean Memorial Volume: Archaic Fishes. The Breeding Habits, Reproductive Organs and External Embryonic Development of Chlamydoselachus, Based on Notes and Drawings by Bashford Dean.* Pp. 523–633. 33 figures. 6 plates. American Museum of Natural History.

LANG, WILLIAM D., STANLEY SMITH and HENRY D. THOMAS. *Index of Paleozoic Coral Genera.* Pp. v + 231. British Museum. 15/.

MERCHANT, I. A. *Veterinary Bacteriology.* Pp. viii + 628. 135 figures. Iowa State College Press, Ames. $7.00.

Pennsylvania State College Bulletin No. 29; Petrology and Genesis of the Third Bradford Sand. PAUL D. KRYNINE. Pp. vi + 134. 37 figures. The College. 50 cents.

THONE, FRANK. *The Microscopic World.* Pp. 245. Illustrated. Messner, New York. $3.00.